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Engineering News-Record

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Concrete Pavement Detailed as a Floor

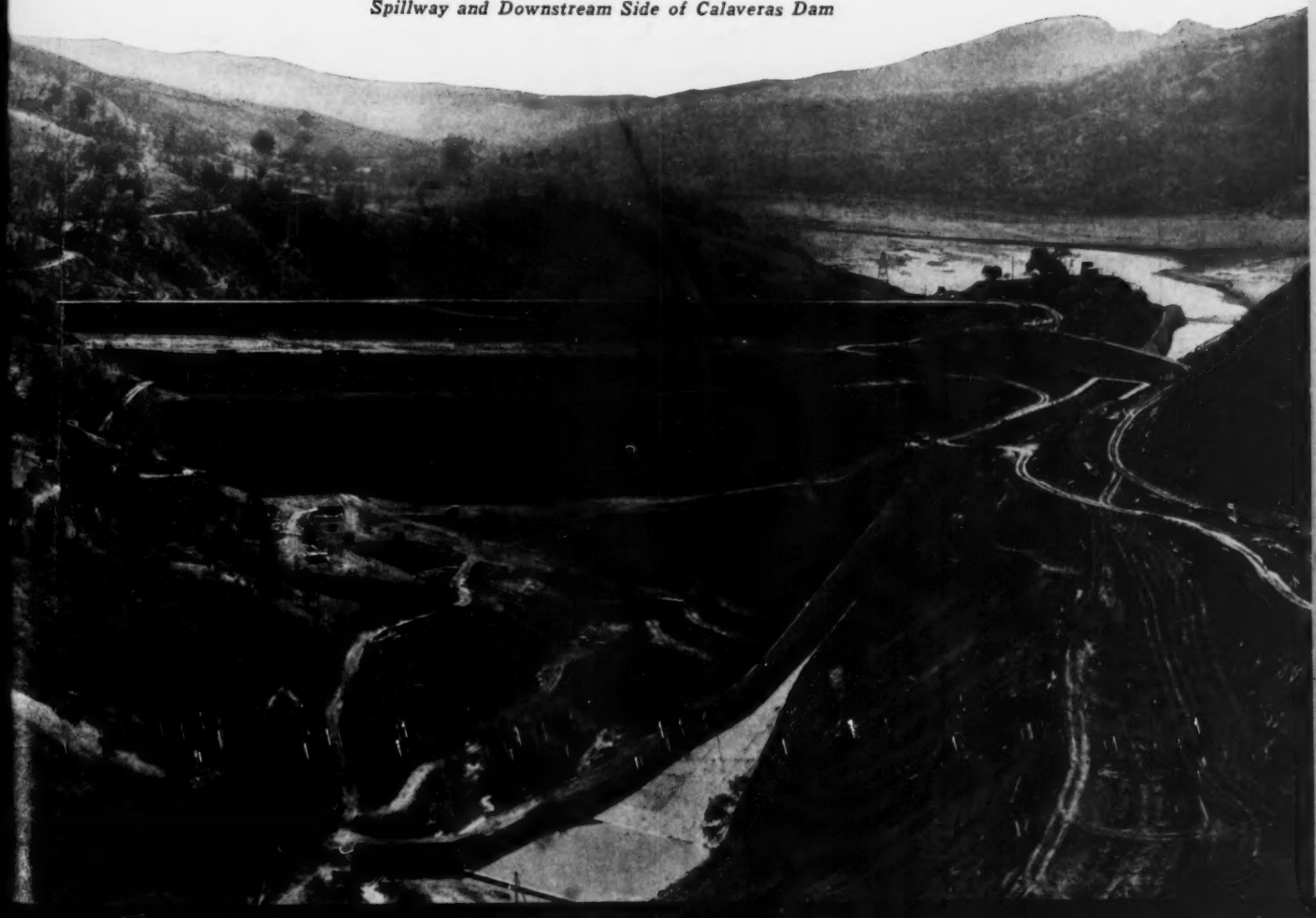
Reconstruction of
Calaveras Dam
by Dry Fill

Difficult Underpinning Work in Building Reconstruction

Toledo
Intercepting Sewer System
Basis for Design

Track Device for Detecting Defects in Rails

Spillway and Downstream Side of Calaveras Dam



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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Spring Prospects

THREE months of 1926 have passed and still the high demand for construction keeps up. The year continues to be ahead of the record year 1925, and there has as yet appeared no sign of a let-down. Will this increased demand continue throughout the year? At present there are some things in sight which would indicate the break that some think is bound soon to come, but for the most part all the customary indices show no sign of change. The only disturbing elements are the continued unrest in the agricultural regions, the possible overproduction of automobiles, the decided liquidation of the stock market and the break in the Florida land boom. However, there is nothing different today in the farm situation than there was a year ago, the automobile manufacturers have before this fooled the pessimists who thought all of us who could buy a car had already done so, the stock market had no business being where it was three months ago, and so far at least it looks as though those who have lost or are going to lose on Florida land were gambling with their surplus and that surplus was so widely distributed that its redistribution will disturb no one. And so one must fall back on the facts—that construction continues to increase, that railroads and municipalities have by no means caught up on their construction demands and that roadbuilding for the year will total more than a billion dollars. By July there may be signs of a diminution in construction; certainly on this first of April such signs are few.

Medieval Rights

ONCE again the New Jersey commuters into New York City are asking the War Department to consider that time really is money. Thousands of man hours are lost every week—to say nothing of the intangible but by no means less serious loss from frayed tempers—because certain river traffic on the Hackensack and the Passaic chooses to use those streams during the hours that hundreds of thousands of working people are pouring into New York City on the New Jersey railroads. Drawbridges must open and open draws mean delays on a railroad which is sending a train a minute into its terminal. All the railroads are asking is that the river be closed to high clearance traffic for an hour or two in the morning and evening when these hundreds of thousands are going to or coming from work. This reasonable request has been refused time and again because the War Department has held that the ancient rights of the waterway must not be denied. Because medieval England traveled easiest by water, modern America en route across land must defer to water borne traffic. It remains to be seen how the Department will regard this latest, and powerfully presented, argument for balanced rights but if once more the request is refused, it is high time that some legislative move be made to correct an abuse. The difficulty lies in the fact that the War Department, in its capacity as the federal supervisor of navigable water, does not consider itself an impartial judge of the relative rights of water and land borne conflicting traffic so much as the defender of the waterway. It is not sufficient to prove to the Department that the total economies of the situation point overwhelmingly toward a restricted use of the waterway; the advocate of drawbridge closing will be turned down if the waterway interests make a slight case of interference with the free use of the channel. We need in Washington not an advocate of the waterway, but a tribunal that will consider the balanced rights of the modern community, regardless of medieval legal precedent, and will decide that a thousand man hours of labor in New York City is more important than withholding a hundred tons of coal from a gas plant for an hour or so or of requiring the crew of a garbage scow to wait fifteen minutes in the evening.

Learning By Misfortune

CALAVERAS DAM is one of the great earth fills of the world. Its first construction, which ended disastrously eight years ago, was in the nature of an experiment for when it failed it was nine-tenths of the way to being the highest water-retaining embankment ever built. That failure, however, while great was by no means overwhelming for it was found that only about one-quarter of the earth had slipped and that the part that remained bore all signs of being permanently stable. Its reconstruction, therefore, while tedious and expensive, was quite possible. In that reconstruction, as the article by its chief engineer on another page shows, the lesson of the failure was studiously observed. That was that the sluiced material which made up the unstable section of the dam was unfitted for hydraulic placing, and that while it was quite possible to obtain sluicing material which would stand every chance of permanence when placed, the cost would be greater than to use a complete dry fill, which all experience has shown to be danger proof. How this was done Mr. Elliott outlines in this final chapter on a famous structure, in the completion of which the engineers have been retarded but not deterred by misfortune.

Ferries Redivivus

ANNOUNCEMENT has just been made that a private company is to build and operate a new fleet of ferry boats across the North River between New Jersey and Manhattan. This is significant news. For years the ferry has been anathema to the transit experts. Its early demise has been regularly predicted and all of the plans for trans-river traffic have aimed at that

end. It has seemed to many that this was most unwise, that the ferry offered a flexible and pleasant service which should not be discarded, and that the argument that water-front property was needed for other purposes was forced in a port with over three hundred miles of shore line. Now come some people who are willing to back the ferry as a private enterprise and to test out in practice the belief that the day of the ferry has by no means gone. All the ferry needs to demonstrate its usefulness is speedy and consecutive service. If the new company institutes short interval schedules other companies may soon be expected, and the theory of the experts that through rail transit is the only solution of New York's trans-river traffic problem will go by the board.

Sewage Sludge Digestion

FOR sewage sludge to hold the attention of sanitary engineers for hours, as was the case at the meeting of the New Jersey Sewage-Works Association on March 27, is nothing new as that has occurred again and again ever since sewage treatment was taken up three quarters of a century ago. Nor is sludge digestion a novel topic, for that has been up for discussion ever since the advent of the septic tank, a quarter century ago. What was particularly significant at Trenton was the new hope of surer methods of sludge digestion control than are now available. Thanks for this are largely due to the New Jersey Sewage-Works Association, an organization that for ten years has stood alone in this country, and more directly to the painstaking work of the New Jersey Sewage Experimental Station, financed by the state and conducted jointly by the State Agricultural Experiment Station and the State Department of Health, with the co-operation of the Plainfield joint sewage disposal works. It is true that the data and opinions on sludge digestion, so enthusiastically and cogently presented by Doctor Rudolfs at the Trenton meeting, are based on laboratory tests but in various particulars they have been supplemented by observations on the Plainfield Imhoff tanks and by practical experience elsewhere. It is encouraging also to note that laboratory experiments at the Harvard Engineering School, mentioned elsewhere in this issue in our report of the Trenton meeting, corroborate Doctor Rudolfs' New Brunswick tests. Those who have followed the general subject will not be surprised to know that the control of sludge digestion promised by the New Jersey experiments centers largely in maintaining an optimum pH in the sludge—or in keeping the acidity-alkalinity index slightly over on the alkalinity side.

Road Slabs Like Floor Slabs

STANDARD slab design is founded on experience and experiment in all states building concrete roads. The advantages in volume and accuracy of construction are so many that the practice may be expected surely to continue despite the frequent contention that true engineering calls for special consideration of pavement section and strength for every material variation in load and subgrade support. This or the alternative of subgrade design and construction to insure uniform supporting power, it is argued, must be the only logical principle of pavement slab design. In this connection the pavement design described by W. H. Wheeler in this issue deserves more than passing attention. Mr. Wheeler is a structural engineer trained and skilled in the practice of reinforced-concrete building and bridge design. He has brought the traditions and practices of his specialty to the task of pavement design and construction which has come in his way to be directed. The results as described in the article and particularly the detail of the contract plans should interest public roads engineers. We advise a careful study of this unusual paving operation.

Hungry for Work

LAST week in Pennsylvania for thirteen public roads construction contracts aggregating $1,725,000 on the basis of the low bids, there were received 179 bids. For the larger and more desirable of the baker's dozen of jobs there were 20, 27 and 29 bidders. "Prices were good" said an engineer of the state highway department, "the boys are hungry for work." So it is, every spring, as certainly as the sap flows. Road contractors rush and scramble for the early contracts and the public roads officials smile and say: "prices are good." And next autumn it will be said that 1926 was not a good year for road contractors but the speakers will be the contractors and they will not be smiling. Then the following spring there will be perhaps 200 bids for the couple of million dollars worth of March road contracts. It is a strange condition. This year Pennsylvania will spend seventy-three million dollars on public roads and something like two-thirds of the money will go for construction. And here are 179 bids for a chance to earn about one-twenty-fifth part—the first measureful from an overflowing bin. Truly contracting is a strange thing.

For Better Engineering Practice

FOR some time a campaign has been in progress to improve certain faulty details of practice of structural engineering in New York City. The organization of steel fabricators there, the Structural Steel Board of Trade, has advised architects and structural engineers that its members may decline to bid on work when the steel plans are incomplete or do not give sufficiently precise information to permit of a safe cost estimate. Incidentally—and we cite it here to show that the organization concerns itself as much with the faults of architectural practice as with those of engineering—it has also protested against vague architectural plans and contract clauses which attempt to lay the whole burden of responsibility for errors upon the contractor. The agitation happens to be carried on only in New York by a local fabricators' body, but the principles involved have country-wide interest and application.

In a recent bulletin, the organization mentioned says: "When an engineer has so much work on hand that he cannot give it a reasonable amount of personal attention; if he is so rushed or so far behind in his work that designs are pushed out without having had his personal study of details and without proper dimensioning, simply in order to make good in having an issue date stamped upon them, the result is most unsatisfactory for both the architect and the owner." The argument is obviously true. In fact, the demand is of a kind that should never have been made by interests

outside of the engineering profession. Engineers should, of their own motion, conduct their practice in such a way that criticism of this kind would be impossible. It is regrettable that the admonition should come from outside and that engineers should not have found it feasible to keep their own house in order.

Yet, such criticism, if appropriate and necessary, is to be welcomed. The pressure of competitive influences in engineering practice often rests heavily on the practitioner. Business demands are apt to seem imperative, and to make strict and satisfactory performance of professional functions impracticable. If under such circumstances objectionable practices come into being, it is better that attention should be called to them by outside interests than that they should survive and continue without check. All influences that work toward better engineering are constructive.

At the present time there does not appear to be any professional organization specifically directed to watching over details of practice such as are here in question, and seeking to maintain performance on a high professional plane. Were there such a body, the complaint of the fabricators would doubtless have been addressed to that body rather than broadcast by issue of a circular. In the active development of engineering society functioning that is now in progress, opportunity may be found for the creation of a professional group or subgroup directed to these ends. It would find real opportunity for service, we believe—only occasionally in reform of bad practice, no doubt, but constantly and effectively in the maintenance of lofty professional standards and in preventing the development of abuses. These things, after all, are vital to the lasting wellbeing of the profession, as well as of the public whom it serves.

Traffic Control Subordinated

IT WAS evident after three days attendance at the conference on Street and Highway Safety at Washington last week that traffic control and the engineer's relation thereto are still occupying only a secondary place in the minds of those who are most concerned with the motor car and its operation. This conference was called by Secretary Hoover both in 1924 and 1926 to consider the serious problem of street and highway accidents. Its fundamental purpose was humanitarian, the saving of life and limb. It is quite obvious that the growing street and highway accident toll is due to the motor car and so naturally the attention of both conferences centered on that vehicle, to study what measures could be adopted and what laws passed to make it more safely operable and operated.

Any consideration of safety on the highways, however, has by connotation to include the whole problem of highway congestion, its regulation and its cure. This was clearly recognized in the organization of both of the conferences and capable committees before each conference thoroughly studied the problems of traffic and its control and reported their findings to the full body. In neither year did that body take any note of these findings other than to place its casual approval on the committee reports. No discussion on the floor, either in 1924 or in 1926, marked the presentation of the engineering features of the committee reports nor was there any sign that the hundreds of delegates considered these features of more than academic interest.

This attitude in the part of the conference might be most discouraging to engineers who are studying the traffic problem did they not realize that for a time at least those who are officially concerned with highway and street accidents must look first into the superficial aspects of the problem. The design of the machine itself, the rules and regulations for its operation, the ready and sure determination of responsibility for accidents and the kind of punishment that will tend to reduce future accidents are the things that seem to them to need immediate attention. And in this view they are supported by the numerous interests who have pocket book necessities to consider. The insurance companies, the motor car manufacturers and dealers and the taxicab and bus operators, all were very much in evidence in Washington last week and in effect took over the conduct of the conference.

As the beginning of the long road which must be traveled in this solution of traffic difficulties, no objection can be made to this. But the engineers must insist that for the long pull these measures are superficial. Once settled the matters of registration of cars, licensing of drivers and enforcement of traffic ordinances will somewhat reduce the accident toll, but the fundamental causes of congestion with the accompaniment of accident lie deeper. This the committee of metropolitan traffic facilities tried to point out this year. So far as the conference itself was concerned the report fell on barren ground, but the committee may be encouraged to believe that its work was not wasted if the various city and state officials who are thinking as much about causes of congestion as of the occurrence of accident take some heed of the committee's recommendations. Those recommendations are not specific; they merely outline the economic sequels of congestion and suggest the possibility of an engineering cure. Each locality has its own peculiar problem, but the committee suggests that there are those who know how to go at the problem in an engineering way and to lay down a plan for future street and highway improvement that may be attacked progressively with chances for progressive improvement of congestion.

The state officials who are concerned with the promulgation of the uniform motor vehicle laws which were made the keystone of the recent conference are relatively few but thousands of towns and cities need advice on traffic control, which not only will reduce accident but will promote convenience of living and save real money. These communities will profit by a study of the recommendations of the metropolitan traffic committee, particularly if they take the advice there given immediately to organize for an intensive study of traffic control under scientific auspices, instead of leaving the solution as it now generally is to local police or political control, which however honest and practical, as a rule looks to tomorrow rather than to next year or the next decade.

The 1926 conference will help along the cause of safety on streets and highways, but it is only a beginning of the long campaign for traffic control. When the motor vehicle and insurance people are assured that everything they are interested in has been taken care of the succeeding conferences will be able to put the full force of their influence behind some of the more basic matters that influence traffic and its control. When that time comes the engineer will be more evident at the conferences than he has been at the first two.

Reconstructing the Calaveras Dam by Dry Fill

Dry-Fill Substituted for Hydraulic Fill After the Slip of 1918—Dam Now 220 Ft. High with Provision for Ultimate Height of 255 Ft.

By G. A. Elliott
Vice-President and Chief Engineer, Spring Valley Water Co., San Francisco, Calif.

For a decade the Calaveras dam of the Spring Valley Water Co., of San Francisco, has been attracting the interest of engineers. First it came to notice as a remarkable hydraulic-fill operation. Then there came the much discussed slip and subsidence of the upstream embankment. There followed temporary repairs, then the work of permanent reconstruction completed last year. Present construction provides for a future increase in height of the dam, so there is a possible remaining chapter to be written in the story of Calaveras. For the moment, however, completion is recorded and that tale is told here by the engineer who has witnessed events from the first. Methods employed in the early stages of the work were described in an article by the present author, published in "Engineering Record," Aug. 19, 1916, p. 220. An account of the slip written by Allen Hazen and Leonard Metcalf, appeared in "Engineering News-Record," April 4, 1918, p. 679. Another discussion of the early work on the dam with relation to the slip, by Allen Hazen, appeared in the issue of Dec. 26, 1918, p. 1158; and a description of raising the dam appeared Jan. 18, 1923, p. 117.—Editor.

Reconstruction of Calaveras dam in California has been completed by the Spring Valley Water Co. The finished structure is an earth and rock dam 220 ft. high above bedrock with a volume of 3,461,000 cu.yd., creating a reservoir with a capacity of 32,800 million gallons. The lower half was built by the hydraulic-fill process which was interrupted by the slipping into the reservoir of 800,000 cu.yd. of the upstream embankment and part of the clay core. Since that time the upper portion has been completed by a rolled clay core supported by uncompacted soft rock banks, dumped in place.

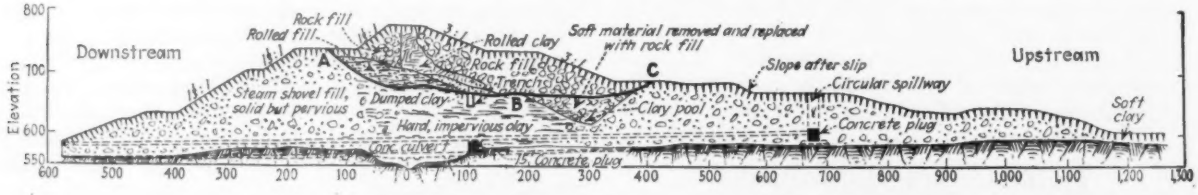


FIG. 1—CROSS-SECTION OF CALAVERAS DAM AS COMPLETED IN 1925

Failure and Emergency Repairs—In March, 1918, following the slide there remained undisturbed within the original limits of the dam 3,000,000 cu.yd. represented by that part lying below the heavy line *ABC*, Fig. 1. The first emergency work after the slip included (1) placing a "rolled fill" to El. 710, (2) building an overflow shaft having an inside diameter of 12 ft. and leading down into the original culvert under the dam, and (3) driving an 8-ft. concrete-lined outlet tunnel 1,490 ft. long through the west abutment. The level of the lake was limited to 65 ft. above the reservoir bottom by the open top of the shaft. In 1920 this shaft was extended to 85 ft. above, and the rolled fill was raised to 120 ft. above, the reservoir floor.

Reconstruction Preliminaries—In 1920, after thorough exploration by well drills, a start was made towards final reconstruction by building a portion of the permanent cutoff. The drill holes indicated that in the central quarter extending upstream from the rolled fill at depths varying from 15 to 40 ft. there existed a solidified body of the original sluiced clay overlain by steam shovel material consisting principally of sandstone and shale. A trench 10 ft. wide was sunk to undisturbed impervious core material along the upstream toe of the rolled fill and was backfilled with clay, which had been trapped during the slide, and which, due to its location under the projected upstream embankment of the contemplated structure, would have to be eventually removed.

Because of the comparatively small amount of material required and the fact that the pit contained masses of rock so that selection was necessary, excavation was by hand. Half-yard mining dump cars running on light portable tracks were used for transportation and the clay was dumped into the trench and tamped in place. As the filling of the trench proceeded all timbers and lagging were removed. In order to avoid the additional depth of excavation which would have been necessary on the center line of the dam, the trench was located upstream at the toe of the rolled fill. At the center of the dam the cutoff was 125 ft. upstream from the center line and thence gradually drew in as the abutments were approached.

Final Plans—In 1921 plans for the completion of the dam were prepared. They called for the construction of a dry-fill earth dam, the central portion to be clay rolled in layers connected to the 10-ft. cutoff, with a section gradually tapering from a width of 100 ft. at El. 700 to 25 ft. at the top. The impervious center was to be supported by loosely dumped sandstone and shale rock, forming a dam with upstream slopes of 3 on 1 separated by two berms, one 50 ft. wide at El. 690 and the second 62 ft. wide at El. 740, the elevation of the floor of the valley being 600 ft. at the dam.

The downstream slopes were left at 1½ on 1, the natural slope of the loose material. Very little material was required for the downstream embankment as this portion of the dam was already at El. 740. The

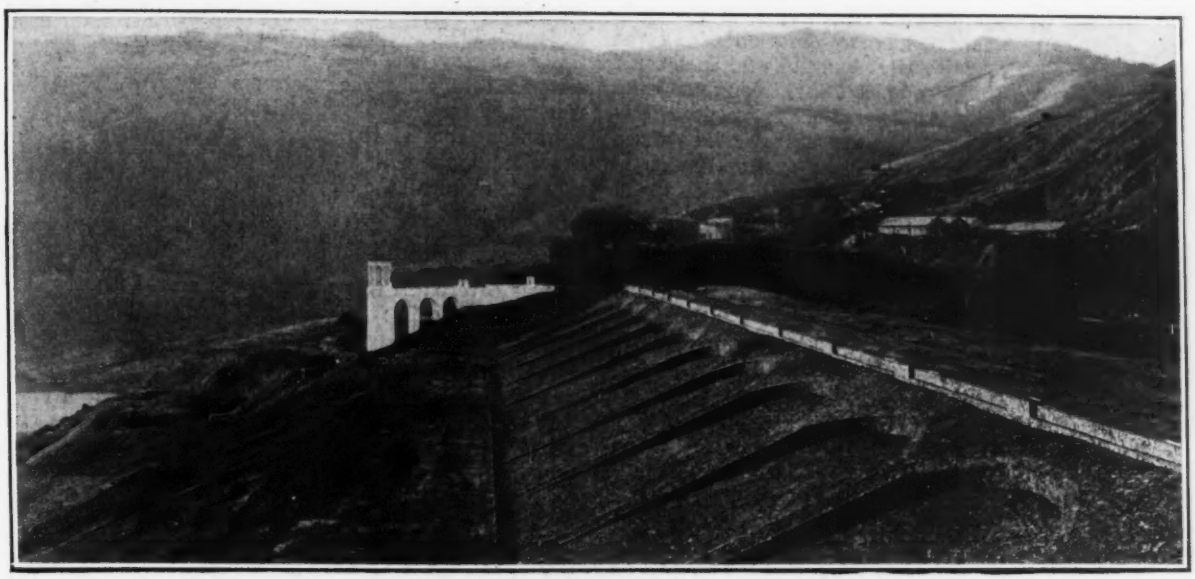


FIG. 2—UPSTREAM FACE AND CREST OF RECONSTRUCTED CALAVERAS DAM
Outlet control structure and architectural treatment that breaks up flat effect of riprap paving. Water at low level in reservoir at left.

crest with a total width of 64 ft. and a length of 1,200 ft. was placed at El. 775. The purpose of leaving the berm at El. 740 was to facilitate the future raising of the dam to El. 810 ft. without unwatering the reservoir. This raising is to be done when additional storage capacity will be required to conserve the runoff of Upper Alameda Creek, a stream that is to be diverted into Calaveras reservoir through a tunnel 9,850 ft. long which is under way.

An outlet consisting of a concrete-lined shaft intersecting the outlet tunnel was located about 450 ft. from the mouth of the tunnel driven after the slip. A spillway with a capacity of 26,500 sec.-ft. equivalent to a runoff of 10 in. of rainfall per day over the entire 100 square miles of drainage area tributary to the reservoir was located immediately west of the dam. These structures are shown by Figs. 2 and 3.

Reasons for Adopting Dry Fill—The decision to adopt

FIG. 3—SPILLWAY AND DOWNSTREAM SIDE OF CALAVERAS DAM
Quarry for embankment material at right. In the center foreground are spillway and stilling pool. Berms were planned with a view to raising the dam.

the plan and method of construction outlined was made only after a most thorough consideration of all the facts affecting the project. A hydraulic-fill dam could have been successfully completed by taking material from the gravel beds in the floor of the reservoir. However, as it was necessary to use the reservoir for storage during the period of construction, a suction dredge of considerable size would have been required which would have had to operate in depths of water varying from practically nothing to 80 ft. In addition to the constantly varying suction lift, the static discharge lift would also experience a seasonal change of from 100 to 175 ft. requiring boosting pumps. It was felt that the first cost of the material and equipment, with small prospect of salvage value, together with the difficulty of operation, would result in an excessive yardage cost.

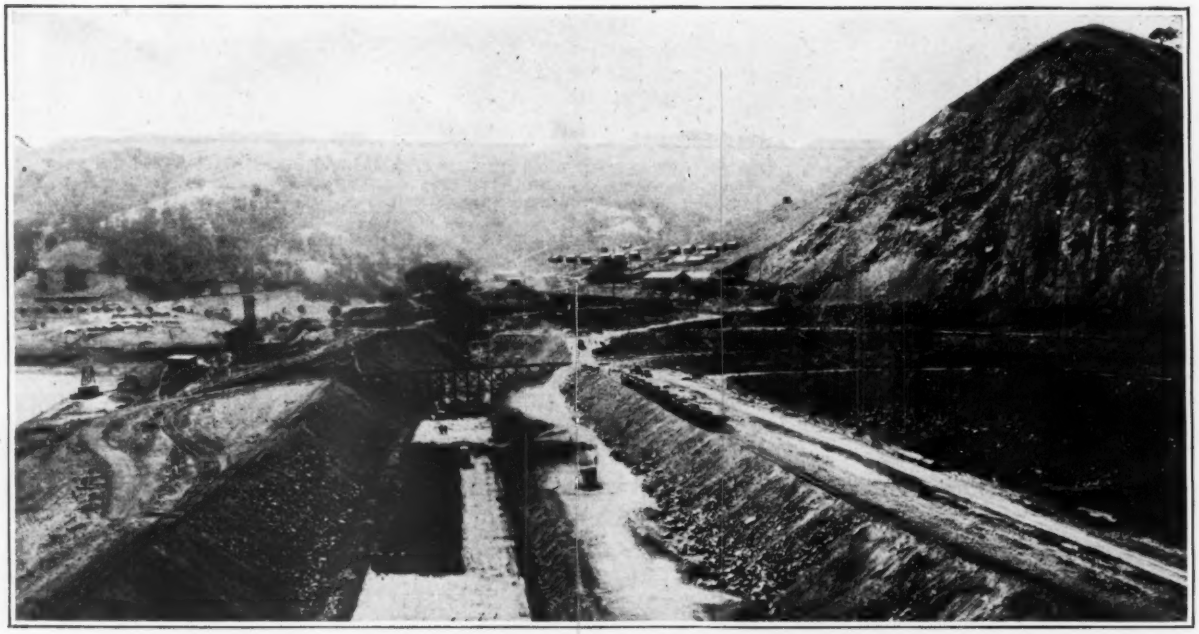


FIG. 4—LOOKING WEST ALONG ROLLED CLAY CORE OF CALAVERAS DAM
Clay core in center with loose embankment on either side. Layers show white after being compacted and black before rolling. Note trestle and tracks for material delivery.

The fact that in the early part of the work over 1,000,000 cu.yd. of sandstone and shale rock had been obtained from a hill within a short transportation distance of the dam, and that the resulting quarry was in readiness for use at an elevation that allowed an easy grade for railroad equipment suggested that this material be used in the greater part of the fill. It was felt that the cost of construction using dry fill was more certain and would not be more than the hydraulic fill under the existing conditions. The former type of structure had the further advantage of eliminating all doubt as to the integrity of the dam as compared to hydraulic fill in view of the slip in 1918. Consideration was given to hydraulicking the core by sluicing the finer material from the face of the dumped quarry fill into a pool maintained at a predetermined width between the up and downstream embankments, but it was finally decided that such a procedure would interfere too much with the continuity of the embankment work and increase the cost.

Dumped Clay Fill—Construction began in September, 1921, with the removal of the "clay pool" which had been trapped near the upstream edge of the dam by the slide of 1918. This removal served two purposes: first, the clay had to be replaced by coarser material on which to place the upstream supporting embankment; and second, it was desirable puddle clay for the permanent core of the dam. A small revolving steam shovel equipped with an orangepeel bucket was used to excavate and load the clay into 4 cu.yd. side dump cars. The cars were hauled up an inclined trestle railroad to the top of the rolled fill and the clay was dumped upon the sloping face of the fill. The entire face of the rolled fill was covered in this manner, the average horizontal thickness being 20 ft. The top of this clay fill extended over and became a part of the clay in the cutoff trench. The consistency of the material was such that it was a homogeneous mass when placed. No movement could be observed when later the rolled clay core was superimposed upon it. The pit from which the clay was removed extending down to El. 610 was afterward filled with rock during the placing of the embankment.

Clay Core and Rock Fill—In September, 1922, a contract was let to Palmer & McBryde for the rolled clay core amounting to 118,420 cu.yd. and the supporting loose fill embankments amounting to 694,334 cu.yd., the first at $1.68 per cu.yd. and the second at $0.55 per cu.yd., both measured in fill. The core material was excavated with a revolving steam shovel, loaded into 4-cu.yd. auto trucks and transported 1¾ miles to the dam, where it was dumped, spread with fresno scrapers, disk-harrowed to break up the lumps and rolled with a 12-ton roller in layers about 6 in. thick, Fig. 4. The average truckload of loose material amounting to 5 cu.yd. was consolidated by rolling to 3.06 cu.yd.

The supporting embankments were built of a shale and soft sandstone rock from a quarry about 1,500 ft. from the dam. An electrically operated shovel with a 2½-cu.yd. bucket mounted on crawler traction was used for excavation. The crawler traction was of great

assistance as the shovel could be kept closer to the face of the pit than is ordinarily possible with railroad truck mounting and it also enabled the shovel to move back rapidly in case of slides. Fewer pit men were required and delays due to moving up and placing track ahead were practically eliminated. The rock was transported to the dam in trains of from three to five 12-cu.yd. air-operated, side-dump cars hauled by dinkey locomotives on standard-gage track. Trestles about 20 ft. high were built across the dam and the material dumped over the edge until a fill had been completed. The fill was then extended in width to meet the rolled center core and the outer limits of the dam.

On the upstream edge of the dam the loose fill naturally lay on a 1½ on 1 slope, and as one layer was superimposed upon another the face assumed a step-like appearance. These layers were extended sufficiently beyond the line of the finished slope so that the 3 on 1 slope line intersected the face of each step at about one-half its height. The triangular projections beyond the final slope were moved down to fill the similar vacant triangles at the toe of each step, by a large land leveler similar in appearance to a scraper. This piece of equipment attached to the front of a 60-hp. crawler tractor successfully transformed the serrated face into a smooth surface. No particular difficulty was encountered in operating the tractor on the steep slope of the loose fill either in going up or down.

It was impossible to keep the supporting embankment in contact with the rolled core at all stages of construction and the tendency for the core to exceed its boundaries was corrected by dumping truckloads of quarry material over its edge forming a temporary support which enabled the impervious center of the dam to be held to the predetermined limits. As the cross-section indicates, the downstream face of the core was carried up vertically. All of the quarry material had to be shot before excavation. Several methods were tried but T-shaped coyote holes at the toe or vertical well drill holes 75 to 100 ft. back from the toe were found to be most satisfactory. Heavy charges of dynamite were used. The largest single shot used 32 tons of powder and broke up 100,000 cu.yd. of material.

Outlet Construction—With the progress of the fill, company forces constructed the outlet works. The control structure consisted of a shaft 19 ft. in diameter and 140 ft. deep, lined with reinforced concrete. A 48-in. riveted standpipe was erected inside the concrete structure. Double-gated water inlets 36 in. in diameter were constructed at four elevations. Three of the inlets required small tunnels to be driven in heavy ground. As the smallest tunnel that could be constructed would be ample to care for the hydraulic requirements, it was decided, in order to avoid the large expense of a concrete lining poured in cramped quarters, to use precast concrete segments. Details of the construction were published in *Engineering News-Record*, Dec. 28, 1922, p. 1119. The location of the outlet tower over the already constructed tunnel suggested that a 16-in. well hole be drilled into the tunnel into which all of the excavated material could be shoveled, allowing the flow through the tunnel to carry it into the streambed below the dam. This plan was successful and decreased the unit cost compared to hoisting excavated material to the surface.

Spillway Construction—The spillway was excavated by the contractor and the spoil deposited in the dam; the reinforced-concrete lining was placed by the company's forces. At the inlet the finished spillway is 150 ft. wide on the bottom and 18 ft. deep with sides on a slope of ¼ on 1. Maintaining the same side slopes the width is gradually decreased to 20 ft. in a length of 600 ft. As the width decreases the grade of the bottom is increased proportionately so that with a flow of 20,000 sec.-ft. the depth of water in the channel is the same at all points. The next 300 ft. of the length is on a grade of 1.1 per cent. The last 450 ft. was built transversely down the face of a hill which had a slope of 75 per cent. The grade of this section of the spillway channel is 23 per cent.

The channel ends in a concrete basin 13 ft. deep, and 100 ft. square whose outlet is partially closed by a wall 5 ft. high. The total length of the spillway is 1,450 ft. and its construction involved the excavation of 160,000 cu.yd. The reinforced-concrete lining placed without expansion joints is 10 in. thick on the bottom, and the wall lining varies from 10 in. at the bottom to 6 in. at the top. Including the stilling pool, 5,590 cu.yd. of reinforced concrete were required.

The somewhat unusual design of the spillway was indicated by the topography of the location. It was desirable for hydraulic reasons to secure an ample water entrance. A short distance beyond the inlet the space available for a channel was restricted to a comparatively narrow area left between the face of a quarry that had been used in the construction of the dam and the edge of the canyon through which Calaveras creek flows. Any encroachment of the channel on the face of the quarry meant that a slab of corresponding thickness extending the full length of the quarry some 400 ft. and reaching to its crest at a height of 400 ft. must be removed. The removal of such a slab not only entailed great expense but also disturbed the face which had not been touched for eight years and might have resulted in slides. The steep slope of the lower end was necessary because of the limited distance in which to reach the stream bed. It is of interest to note that the part of the channel built down the face of the hill was excavated entirely by a small revolving shovel and the waste disposed of by auto trucks.

The work was performed under the field direction of T. W. Espy, assistant chief engineer of the Spring Valley Water Co. All plans were prepared by I. E. Flaa, office engineer.

Cost of Detours in Connecticut

For the laying-out and maintaining of detours in Connecticut during the active road-construction season of 1925, the state highway department expended $63,860. The work, which involves the creation of suitable substitute roadways encircling roads closed for construction activities, extended from April 1 to Dec. 31, 1925. The largest expenditure in connection with this activity was for maintenance of one-way traffic, including special guards and a system of field communication by telephone from each end of the one-way traffic posts. An aggregate of 1,378 signs of varying sizes was used at a total cost of $6,603.39. A total of 141 miles of detours was required throughout the year, and the total cost of repairing these roads and restoring them to their former condition before heavy traffic was transferred over them, was $15,228.65. A total of 52,000 gal. of road oil was used on these surfaces and the cost of inspection of the travel paths, signs, lights and investigating complaints amounted to $3,926.16.

A Concrete Pavement Detailed as a Floor Is Detailed

Slab Section and Reinforcement Varied With Changing Conditions and Location and Detail Plans Provided

By Walter H. Wheeler
Designing and Consulting Engineer, Minneapolis, Minn.

THE writer has believed for some time that experience will show that concrete pavements reinforced somewhat along the lines of reinforced-concrete floor slabs are good practice on rural highways. Such pavements are frequently laid on subgrades that have not been consolidated by years of traffic. Soft spots or slight settlements in such subgrades are likely to develop. It is self-evident that a pavement which is not reinforced to act as a slab will break under heavy wheel loads if the subgrade yields enough to produce important bending and shearing stresses, whereas properly reinforced slabs will withstand much greater bending stresses without fracture. Pavement slabs are subjected to both positive and negative bending. Negative bending is most likely to occur along the edges of pavement slabs but it may also occur in the middle of such slabs. The writer believes that these characteristics of pavement slabs have been so thoroughly demonstrated in the field and by tests that they may be considered established facts.

Therefore in designing concrete pavement for the approach roads to the Fort Snelling-Mendota bridge the writer decided to apply the principles above discussed. A further reason for reaching this decision was that the roads to be paved are largely new roads, located and graded as a part of the Fort Snelling-Mendota bridge project. The contract for grading the approach on the Mendota side of the Minnesota River was let in the fall of 1923, some four months before the contract for constructing the bridge was let, in order to complete the heaviest fills as early as possible, and allow them the maximum time for settlement before paving. The grading contract on the Fort Snelling side was let in 1924 and the paving of the approach roads was laid in the late summer and fall of 1925 except a short stretch of paving at each bridge head which was left until 1926 so this work will be completed coincidently with the completion of the bridge.

The subgrade is mostly sand and clay loam, but there are some sections where the subgrade is underlain with thick layers of clay near the surface. There are also stretches of sand and gravel subgrade.

In all there are about five miles of approach paving in the project. The pavement is 27 ft. wide, except about one-half mile in the main post at Fort Snelling which is 36 ft. with a 9-in. curb, and about 900 ft. in a deep cut where the pavement has 5-ft. reinforced-concrete gutters on each side to carry the water through the cut.

The 27-ft. pavement is divided into three 9-ft. traffic lanes by two continuous steel contraction plates. A cap strip is used on the top of the plates. This strip is removed after the finishing is complete and the joint is tooled with a mason's jointer before the concrete takes its initial set. This method leaves an open joint in the pavement surface. After curing is completed and the earth covering is removed the joints are filled with tar. Thus the traffic lanes are quite permanently marked. Transverse joints similarly constructed are placed at 36-ft. intervals and these are also filled with tar. Asphalt expansion joints are placed at intervals. The distance between these joints has varied from 108 ft. to 216 ft. depending upon the air temperature when the pavement was laid and other conditions. In the 36-ft. pavement only one longitudinal joint is made on the center line of the pavement. The pavement is the standard thickness adopted by the Minnesota State Highway Department, namely 8 in. at the outer edge and 7 in. at the crown.

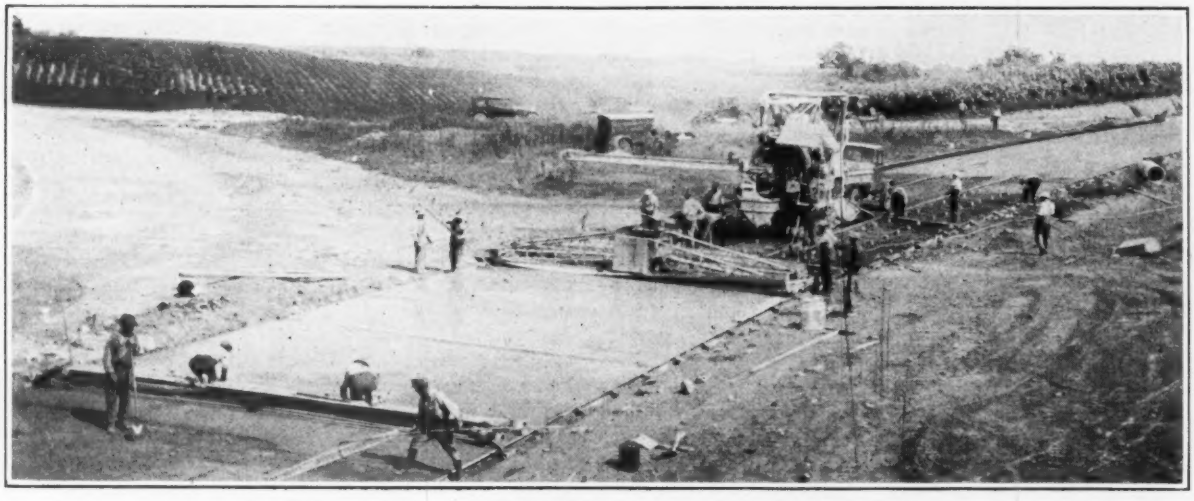


FIG. 1—PAVING OUTFIT WORKING ON 27-FT. CONCRETE ROAD

The details of the reinforcing are shown in the accompanying full details plans. It will be noted that top and bottom reinforcing is provided. The top layer of reinforcing is held firmly in position by bolster bars which are supported on precast concrete blocks. These blocks were specified and detailed and have ties built into them for attaching the bolster bars. The bottom layer of reinforcing is suspended 1 in. above the ground by wire hangers from the bolster bars. There is twice as much transverse steel in the bottom of each slab over the middle area as in the top. One-half of the bottom layer of transverse steel is bent up to the top about

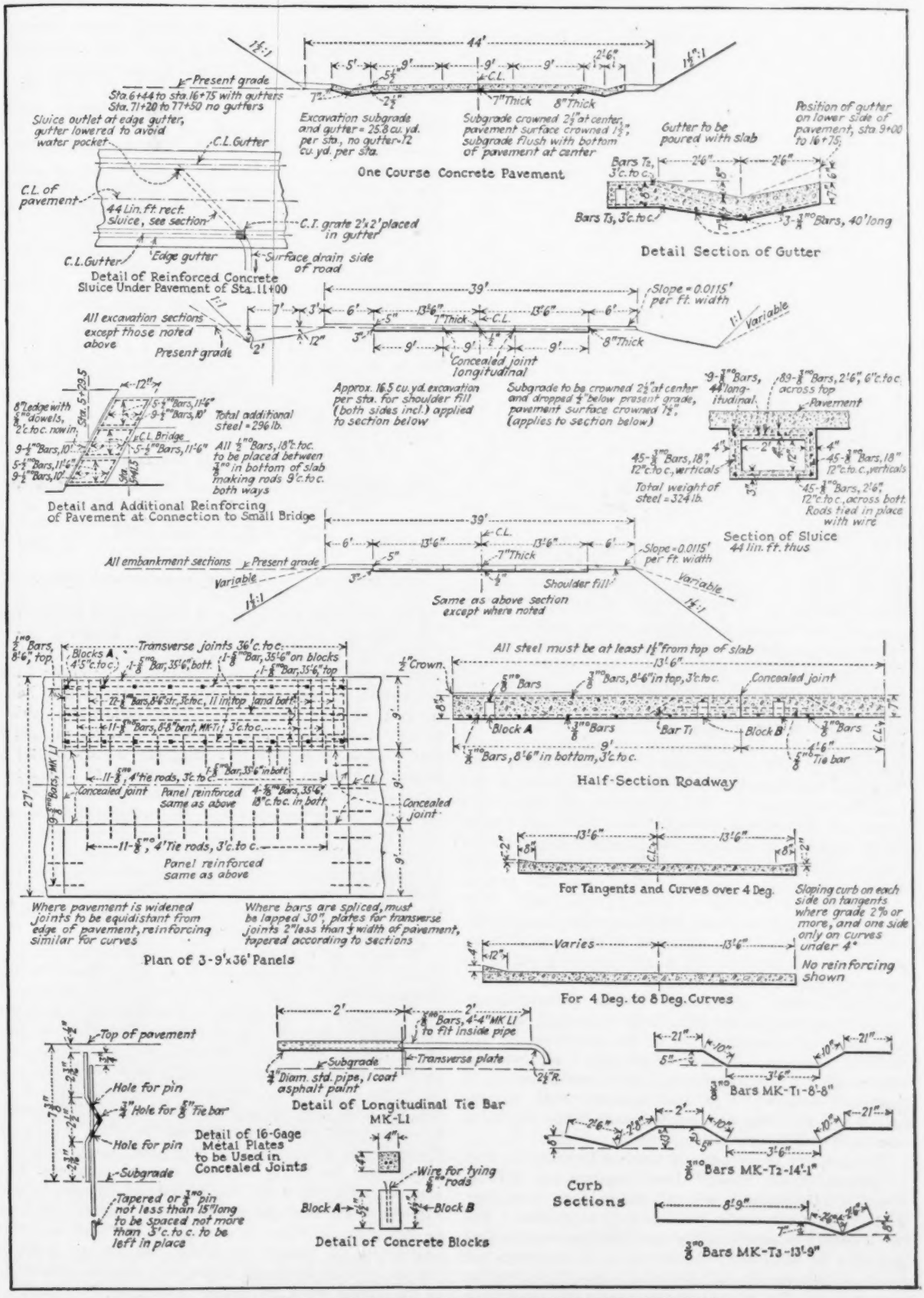

One Course Concrete Pavement
Detail Section of Gutter
Detail of Reinforced Concrete Sluice Under Pavement of Sta. 11+00
Detail and Additional Reinforcing of Pavement at Connection to Small Bridge
Section of Sluice 44 lin. ft. thus
Same as above section except where noted
Plan of 3-9'x36' Panels
Half-Section Roadway
For Tangents and Curves over 4 Deg.
For 4 Deg. to 8 Deg. Curves
Detail of Longitudinal Tie Bar MK-L1
Detail of 16-Gage Metal Plates to be Used in Concealed Joints
Detail of Concrete Blocks
Curb Sections
Present grade
Concealed joint
Subgrade
Shoulder fill
Variable
Slope = 0.0115' per ft. width
Transverse joints 36' c. to c.
Panel reinforced same as above
Concealed joint
Hole for pin
Subgrade
Transverse plate
Wire for tying rods
Block A
Block B
Top of pavement

FIG. 2—DETAIL SHEET OF SPECIALLY DESIGNED CONCRETE ROAD

The rather minute detailing, dimensioning and notation of the plans are given as bringing out the author's idea of designing road pavements slab with all the particularity with which a building floor is designed.

2 ft. 6 in. from each end so that along the edges of each slab there is twice as much transverse steel in the top of the slab as there is in the bottom. Dowels are run through all longitudinal joints and both ends of these dowels are built solidly into the concrete. Dowels are run through all transverse joints. These dowels have one end built solidly into the concrete and the other end enclosed in a 2-ft. length of pipe. The pipe is built into the concrete but the dowel is free to move longitudinally within the pipe. Before placing the dowel bars within the pipes the ends of the dowel bars to be enclosed are immersed in liquid asphalt for 2 ft. 1 in. of their length to prevent the bars from corroding and binding within the pipes.

At the ends of the Fort Snelling-Mendota bridge and also at the two ends of a viaduct over the C. M. & St. P. R.R. tracks in the Mendota approach road, there are special paving slabs. These slabs rest on the end abutment walls of the bridges and are doweled to the bridge floor, with an asphalt joint at the connection. They are the full width of the pavement and 12 ft. long and heavily reinforced. They are joined to the standard pavement slab by a doweled joint similar to the other transverse joints in the pavement. The purpose of these slabs is to maintain smooth connections with the bridge floors.

The aggregates are washed sand and gravel, selected for durability, hardness and frost-proof qualities and are carefully graded in size. The maximum size of coarse aggregate is 2 in. All cement and steel is sampled and tested as shipped. Test cylinders are taken at intervals from the concrete. Accurate control of water is maintained. The slump test is used only as a check. The concrete is required to remain in the mixer for 24 revolutions of the drum and a batch meter is used on the mixer to control the time of mixing. The aggregates are unloaded in stockpiles and from the stockpiles into steel storage bins. The bins are equipped with batchers to measure the aggregates accurately. The aggregates and cement are measured at a central proportioning plant and hauled to the mixer in trucks carrying two batches. Five-bag batches are used, the cement being handled directly from railroad cars on the siding into the trucks. Aggregates are inspected on arrival at the plant. Four men are required to handle the engineering and inspection. One inspector is stationed at the proportioning plant, one inspector at the mixer, one man serves as rodman, chain man and general utility man, and the resident engineer sets stakes and has general supervision of the work. Complete daily reports of the work are made on printed forms to the engineers by the resident engineer. These reports cover all essential details of the work including daily quantities of all materials received, used and on hand with records of inspection. Thus very perfect engineering control is exercised over the work.

The concrete is tamped and finished by machine, Fig. 1, followed by a "darby," hand floating and belting. The 27-ft. pavement is laid full width in one operation. The 36-ft. pavement is laid one-half at a time. Wet earth curing is used and the specifications require that one man be stationed on each 1,000 ft. of completed pavement whose sole duty is to keep the earth covering wet down all day and each day by sprinkling with a ¾-in. hose for 7 days from the day the concrete is laid.

The contract price for the pavement complete is $2.22 per square yard on one side of the river and $2.20 per square yard on the other side. The pavement, including fine grading, sluices, drains, integral curb, guard rails and all incidentals, is costing about $2.45 per square yard. The price with limestone coarse aggregate was 3 cents less per square yard but the limestone upon which the price was based would not meet the frost test and was therefore not accepted. The contractor is an engineer. He states that the actual cost of the pavement is working out as estimated by him and is satisfactory from his standpoint. This is one of the essentials of successful engineering construction which is often overlooked by engineers and owners.

The pavement is being laid by Hennepin County. The paving contractor is the Woodrich Construction Co., of Minneapolis. Walter H. Wheeler and C. A. P. Turner Co., Associated, are the engineers for the county and W. C. Jorgenson is resident engineer on construction.

Track Device for Detecting Defects in Rails

Japanese Engineers Develop Electric Apparatus for Use on Track—Applied Also in Laboratory or Rail Yard

By M. Suzuky

Engineer, Research Office, Japanese Government Railways, Tokyo, Japan

TO DETECT and locate in rails in the track such internal defects as transverse fissures, spots affected by abnormal stresses and segregation of impurities due to careless manufacture or improper heat treatment, a portable magnetic apparatus has been devised in our laboratory. This apparatus, which utilizes magnetic induction by the leakage magnetic flux method, is known as a magnetic defectoscope. A larger but more complicated apparatus of the same general type, but using the total magnetic flux method, was invented by the late Dr. P. H. Dudley and described in *Iron Age*, 1921, p. 1271. It was not portable, and about 25 minutes were required to complete a series of observations on a single rail, including the time for placing and removing the rail. With our apparatus the time is only one to two minutes, while in the track about 100 rails can be tested in an hour.

When a ferro-magnetic substance such as steel is placed in an intense magnetic field, it becomes a strong magnet through magnetic induction. The intensity of magnetization, or the magnetic permeability, is affected seriously by heat treatment, mechanical stresses and the existence of slag or other impurities. If an exploring coil fitted to the test rail is slid along the rail while the induced current then produced in the coil is measured by a galvanometer, the leakage of magnetic lines of force will be determined. In other words, if the rail steel is homogeneous, with permeability uniform throughout its length and the leakage magnetic flux also constant, there will be no induced current in the exploring coil and the galvanometer mirror will not be deflected. If there is a fault in the steel and the uniformity of leakage is broken locally, an induced current will be produced in the coil, causing deflection of the mirror when the device passes over this fault.

This defectoscope is shown in Fig. 1, with the electromagnet on the rail, the recording apparatus at the left

and the section car carrying the batteries and other apparatus. At each end of the electro-magnet, Fig. 2, are placed four rollers to facilitate moving the device along the rail. In the recording apparatus, a sliding block having a lateral motion has a pointer which follows the reflected image of the light spot coming from the galvanometer mirror and moving to and fro

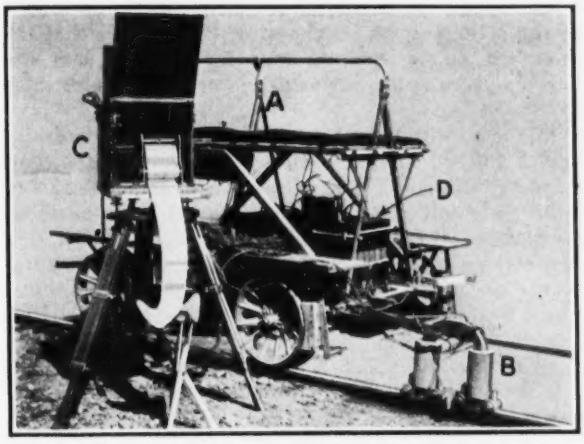


FIG. 1—DEFECTOSCOPE TESTING RAILS IN TRACK
A, car on which apparatus is mounted; B, electro-magnetic detector; C, recording apparatus; D, batteries.

on a plate of frosted glass. This block also carries a pen which traces a line on the traveling roll of paper, while a fixed pen traces a datum line. The exploring coil consists of very fine copper wire wound with silk, and is completely insulated with mica plate to prevent any external current from affecting the coil. Lead wires extend to the galvanometer. From the form of this coil it is not affected by magnetic lines of force, or magnetic flux, passing through the rail.

Examples of recorded curves, shown in Fig. 3, are from 60-lb. 33-ft. rails, the first three being old and

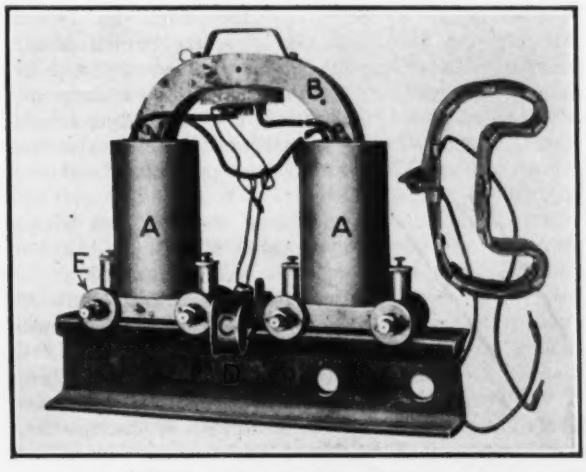


FIG. 2—ELECTRO-MAGNET ON RAIL
A, magnetizing coil; B, iron core; C, exploring coil; D, rail; E, rollers. At the right is an enlarged view of the exploring coil.

the last one a new rail. In the top diagram, a sudden and large deflection of the galvanometer indicated a transverse fissure. The second is for a good homogeneous rail, showing no marked deflection except that caused by the initial movement of the magnet. The third diagram is for a rail that had a faulty portion and an internal stress that was not uniform. In the fourth diagram, from a new rail, the large deflections at equal distances are due to excessive stress at points pressed by the rail straightening machine or gagging press, the deflections being large but slow. Preliminary experiments were made on rails having artificial defects made by saws and drills.

In a test on an old rail, the device recorded a large deflection, but when the rail was broken at this point with a rail bender no defect was visible. Microscopic examinations showed no irregularity in carbon. Finally, a hardness test with Shore's scleroscope showed averages of 24 and 19 at spots with and without defects, respectively, this great difference in hardness being due to abnormal stress applied from the outside at the time of cold working in the mill. A similar test on another rail showed high sulphur content at points indicated as defective. In still another test, a cavity in the rail was disclosed, and there was found to be a carbon content of 0.1 per cent near the cavity and 0.2 per cent in the sound portion of the rail. This was evidently a shrinkage cavity in the ingot, decarburization taking place near the cavity at high temperature.

That the large deflections of the apparatus in the fourth rail of Fig. 3 can be attributed to great local abnormal stress due to straightening in the gagging press, and that hardness at these spots may be considered as the effect of cold straightening, is indicated

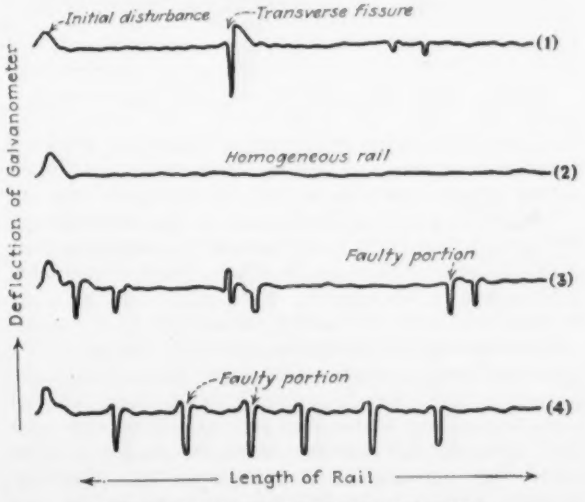


FIG. 3—RECORD CURVES FROM RAILS

by a test on another rail which showed faulty portions. Test pieces were cut out and hardness tests showed 28 and 32 for the sound and defective portions respectively by the Shore method, and 204 and 211 by the Brinell method. As the microscopic structure showed practically no difference, the large deflections recorded by the defectoscope may be regarded as the effect mainly of the pressure in the straightening machine. Furthermore, by comparing the results of several hardness tests it was found that the sound portion had uniform hardness, while in the faulty portion very hard spots were included among other less hard, which indicated the pressure of abnormal internal stresses given to the rail when it was manufactured.

Tests in Track—Breakages of 60-lb. rails of foreign make, laid in track in 1887 on the Tohoku (Northeastern) main line have occurred principally in spring and autumn. There were 12 breaks in 1920, 20 in 1921 and 12 in the first six months of 1922. The breakage was regarded as mainly due to transverse fissures, which characterize some foreign-made rails. In a field test made with our apparatus, the majority were good rails, but some of them had got lapped at the time of rolling, due to poor ingots. In some cases, this defect was visible from outside; in others, a transverse fissure and split head were found intermingled, as in the left-hand rail of Fig. 4. It is noticeable that a clear nucleus crack is found in the fracture. Other deflection of the curve, judging from its slow movement, appears mainly due to stress given to the rail during manufacture. Another rail taken out of track on account of a large deflection of curve recorded, showed very clearly a typical transverse fissure as shown in Fig. 4.

In short, the internal transverse fissure, which is

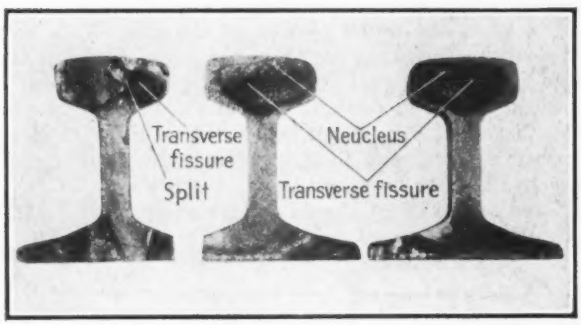


FIG. 4—RAIL DEFECTS FOUND BY DEFECTOSCOPE

the worst defect in rails and is also one of the principal causes for simple breakage of rails laid on track for a long period, can clearly be distinguished from the sudden deflections in curves due to the movement of the spot of light from the galvanometer, resulting from such fissures. But in rails where the nucleus crack has not grown large, the shifting of the spot of light is rapid but small, so careful observation is necessary.

Summary—Rails recorded as faulty by our apparatus have also been proved so by other mechanical tests. According to the results so far obtained, three different kinds of internal defects of rail are detectable with our apparatus: (1) internal cracks and cavities or blow holes; (2) segregation of impurities; (3) abnormal internal stresses, mostly due to pressure by the straightening machine. Of these three, deflections of the galvanometer due to the first being comparatively rapid, can be distinguished from slower ones due to the other two. The second is not so serious as to make the affected rails necessarily unserviceable. The third may be insignificant if the carbon content be low; but if it is high, there will be risks of serious rail failure.

Among merits of our device are simplicity, as well as distinctness and accuracy in detecting various defects; that is, the curves recorded enable faulty portions to be distinguished clearly from sound or faultless portions. It may be applied to rails already laid in track, also to rails just purchased and not yet in service. The time required for testing one rail is about one or two minutes. Where rails can easily be handled or are in track, 100 may be tested in an hour.

Middle Rio Grande Conservancy Project Under Way

WITH the recent selection of J. L. Burkholder as chief engineer and the Dayton Morgan Engineering Co. as consulting engineers, the Middle Rio Grande Conservancy District, New Mexico, is in position to move ahead rapidly. Quite complete reports have been made in the past on all phases of the work so that the engineers do not have to wait for surveys, dam site borings, levee or drainage ditch locations or water table investigations.

In general the project comprises irrigation and drainage of 150,000 acres of fertile bottom land in the comparatively narrow valley of the Rio Grande one to five miles wide and 124 miles long from 27 miles north of Albuquerque to 97 miles south of it. To make this feasible one or more storage dams holding 200,000 acre-ft. are essential, augmented by levees for flood protection. Drainage ditches will be excavated and the river straightened, giving it a scouring velocity and thus lowering the bed, which has in forty-five years built up 7 to 9 ft. through the entire valley and caused a flow away from the river, resulting in "seeped" or water-logged alkaline lands in the contiguous flood plain and an evaporation loss estimated at 1,200,000 acre-ft. annually.

Drainage ditches have already been excavated through about one-tenth of the area belonging to the Pueblo Indians, under the direction of Gen. H. F. Robinson, supervising engineer. Though these were completed only last fall their effect as noted in March by a representative of *Engineering News-Record* is remarkable. Areas formerly said to be white with alkali are now growing crops for at least a mile on either side of the ditches.

The river coursed one time through the center of Albuquerque and the bed is now above the main business section. It will therefore be called on to contribute its share of cost of the flood protection and give stability to bond issues of the Conservancy District. This is probably the first time city property, which usually benefits without paying, will be assessed for back-country development. Before reclamation the farm land is valued at $6,000,000. It will rise (according to estimates) to $15,000,000 afterward, but the city valuations are estimated to increase from a present valuation of $25,000,000 to $50,000,000.

Mr. Burkholder, with whom contract was signed March 8, will take active charge May 1. A board of consulting engineers has also been designated as follows: Gen. H. F. Robinson; George M. Neel, state engineer; Edmund Ross, Bernolillo County engineer; James N. Gladding, consulting engineer; M. C. Blanchard, chief engineer, Santa Fé Western Lines; E. H. Wells, president, New Mexico School of Mines; L. M. Lawson, engineer, U. S. Bureau of Reclamation; and Thomas T. Eyre, dean, engineering department, New Mexico State University. J. C. Smith, secretary, maintains offices of the District at Albuquerque.

For preliminary expenses a levy of 50c. per acre has been made by the counties as provided for in the act, which has been held constitutional by the New Mexico Supreme Court through decision of a test case. With the assistance of A. E. Morgan the law was patterned after those in Ohio and Colorado under which the Miami and Pueblo Conservancy Districts were formed.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

NEW CITY HALL, ST. JOSEPH, MO.

St. Joseph, Mo.

COUNTY SEAT OF BUCHANAN COUNTY, MISSOURI. Sixty miles north of Kansas City on the Missouri River. Situated in a rich farming country noted for its diversified agricultural products. It is one of the oldest middle western cities having been the eastern terminus of the famous Pony Express and the principal outfitting point for many years previous. The city is served by six railroads, the Burlington, Santa Fé, Rock Island, Union Pacific, Missouri Pacific and Chicago Great Western. In addition there are two belt line railways. Hourly interurban trains run to Kansas City and another interurban extends about 12 miles northward. Paved highways carrying buses radiate in all directions and the Jefferson and the Pikes Peak highways cross here. The large industry of the city is the stock yards with wholesale dry goods a close second. Large stationery works, a pancake flour mill, highway marker factory, drug and chemical works and a harness factory are among the other important industries. The city is now building a 600-acre park system 7 miles long enclosing 3 sides of the city; the river forms the western boundary. It also boasts a municipal landing field with a seaplane landing, municipal golf course, and an athletic field. The city was founded in 1826. Pop. (1920), 78,000.

ONE HUNDRED years ago this year a young Frenchman, Joseph Robidoux, founded the city of St. Joseph, or St. Joe, as it is invariably called, on the east bank of the Missouri River, 60 miles north of what is now Kansas City. The city is situated on a bend in the river and today has assumed a crescent shape around this bend.

Robidoux visioned a river city supported by the river traffic, bringing supplies for the plainsmen who were exploring and settling the prairie country for hundreds of miles in every direction. He made comprehensive plans accordingly. Several streets 100 ft. wide, and others with a width of 70 to 80 ft. were laid out running north and south parallel to the river. The east and west streets were made only 50 to 60 ft. wide. Unfortunately, the coming of the railroad ruined Robidoux' plan for a great river city. The steamboat traffic dwindled, and finally ceased altogether. The railway developed and set up entirely different traffic requirements; the cross streets became business streets, and the main streets became residence streets. The result is that now the main street has a total width of 50 ft., with a distance of 30 ft. between curbs, and traffic congestion is increasing. None of the cross streets, and none of the 70 and 80-ft. north and south streets have been changed since they were originally laid out. However, some of the 100-ft. streets have been reduced in width to 60 and 80 ft.

Comprehensive City Engineering—The city engineer of St. Joe occupies a position unique among the majority of his fellows. In fact, the position carries with it a goodly number of the powers and privileges recommended for city engineers in the article published in *Engineering News-Record*, Jan. 14, 1926, p. 76, based on a study of engineering departments in cities under 100,000. W. K. Seitz, city engineer of St. Joe, has practically made his position what it is and a few notes on his history and policies are interesting and practical. Mr. Seitz came to St. Joe as assistant city engineer in 1907, staying for three years after which he went with the city park board. Incidentally the city has just received title to 600 acres of land in and around the city and upon part of it work is now under way to establish a comprehensive park system. The system as planned forms a crescent around the city and is about 7 miles long.

Mr. Seitz was appointed city engineer in 1919 but shortly after sensing possibilities for an engineer in the city manager plan of government went to Wichita, Kansas, as consulting engineer to the city manager. After holding this position for six months he was asked to return to St. Joe as city engineer. As consulting engineer to Wichita he had had forcefully brought to him the true status of a city engineer and he consented to return to St. Joe provided only that no politics was to enter into his office and that he should act as advisor and consultant to every department of the city in any of its work having an engineering nature. His terms were accepted and he now receives 40 per cent more salary than the mayor.

That the city engineer of St. Joe really directs all the engineering of the city as a result of this original understanding is best illustrated by a few examples.

A short time ago, the city was in the market for a large order of fire equipment. Salesmen's claims as to pump and engine efficiencies were not considered but the fire chief, the city engineer and several members of the city council visited the plants of a half dozen manufacturers in different parts of the country where private tests were conducted. As a result of this trip the city engineer prepared a lengthy report based on test data and recommended that a certain type of equipment be purchased. The equipment was ordered immediately. The editor can attest to the efficiency of the fire chief's car as he was given an exciting 10-minute ride through city traffic in order to overtake a limited interurban train that had left the down station bound for Kansas City.

Designation of arterial streets and planning traffic regulation are engineering problems that the city engineer has under his control. At the present time electric "stop and go" signals are being experimented with in the downtown district by the city engineer. As soon as he develops what he believes is a satisfactory system about 60 of these signals will be erected in different parts of the city that have been selected by the city engineer as a result of traffic studies. He also works with the fire chief in relocating and rearranging the fire stations of the city as based on effective radius of equipment.

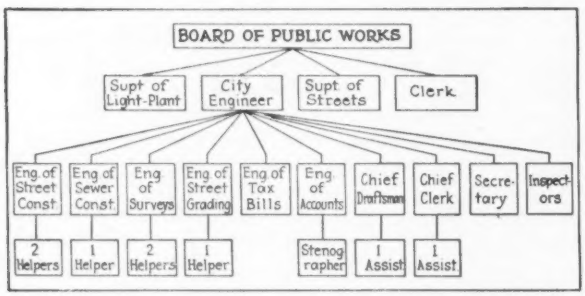
The city building inspector is required to approve all architects' drawings for new buildings or alterations. These plans are turned over to the city engineer's office where they are thoroughly checked. The building inspector signs them after they have been approved by the city engineer.

A municipal landing field for airplanes was considered necessary. A citizen of the town who was an

airplane enthusiast and knew what a landing field should encompass was asked to accompany the city engineer on an inspection trip of landing fields in other cities. Then the two men flew over St. Joe in a plane picking out the most desirable spots. These were checked by preliminary surveys on the ground and a site was finally chosen. The field is 140 acres in extent, perfectly flat, situated on the Missouri River with a landing harbor for seaplanes. It is 12 min. from the post office on a concrete road. The first hangar is now under construction.

These examples serve to show the city engineer's importance in all the departments of the city for his duties are by no means confined to the department of public works. The president of the council told the editor that the city engineer was the connecting link between each administration and that in his opinion for the lay official to disregard the city engineer's recommendations was suicidal. "We always ask for them and accept them without question."

Administration—St. Joe has the mayor-council form



MUNICIPAL PUBLIC WORKS ORGANIZATION, ST. JOSEPH

of government. The city engineer is an appointee of the Board of Public Works, the only salaried board in the city. One of the members receives $1,800 and the other two each receive $1,500 per year. The board meets for two hours each day at which time any citizen may present his grievances and suggestions to it.

The city engineer superintends the construction of all public work except parks and boulevards; these are under the direction of the park board with which the city engineer is connected in an advisory capacity. He also prepares all ordinances covering public work subject to review of the legal department.

The city engineer has a free hand in all technical matters and makes all appointments to his staff which is shown in the accompanying chart. The engineers of street construction, sewer construction, surveys, and street grading are old in the city service, two of them having formerly held the office of city engineer. An engineer of street grading is necessary because of the many hills in the city. "A 10 or 12 per cent grade is looked upon as a blessing." The maximum grade is about 25 per cent. The highest point in the city is 300 ft. above the Missouri River and rises almost vertically from it. The engineer of tax bills is necessary because of the complicated system of distributing the cost of certain public works. This system is the result of a state law applying to cities of the first class. St. Joe is the only city of this class in the state.

As will be noted from the chart the superintendent of streets has a parallel position with the city engineer. He acts, however, under the direction of the city engineer in all matters requiring technical knowledge. He

Engineering Work

has charge of all repair work on sewers and streets. In matters of sewer repair, however, the city engineer usually consults direct with the construction foreman.

Finance—The engineering budget for the fiscal year ending in April is $34,600. This is for routine design and construction. The new park improvement is being financed by special assessment on a benefit district. Each property owner pays a certain amount of his assessment at once, the city issuing and selling park certificates for the balance. The certificates are retired by the property owner paying to the city 5 per cent of his balance each year.

For other large construction bond isues are used. At the present time a new city hall, a new city hospital and several sewers are being financed in this way.

Repair work is done from general revenues, about $100,000 being spent annually, most of it being for street work.

All pavement reconstruction is done by means of the tax bills previously referred to. A description of the procedure used in allocating expense under these bills is interesting. The grading cost is first determined. A sidewalk width on each side of the street, usually 6 ft. wide, is paid for on a straight front-foot basis. The balance of the street is paid for per dollar valuation on property one-half block on either side. In case the adjacent area is not subdivided the distance taken is 150 ft. on either side.

The paving cost distribution is somewhat more complicated. The front-foot cost is first figured followed by the calculation of the area of the blocks on either side. One-half of this area is divided into three equal zones parallel to the street. Where a block is over 700 ft. deep an area 350 ft. by the width is divided into the three zones. The zone facing the street is charged 50 per cent of the front-foot cost, the one behind it 30 per cent and the last or back zone 20 per cent. The cost distributed to each zone is then divided by the area of the zone for a square foot cost. All curb, sidewalk and driveway is paid for by abutting property owners.

Paving—Four classes of pavement are laid in St. Joe. The highest type used on heavy traffic streets is a 3-in. wire-cut brick pavement on an 8-in. base of 1:2½:5 concrete. An asphalt filler is used. Some property owners have demanded asphalt and a 1½-in. binder with a 2-in. top is used, on an 8-in. concrete base. The 3½-in. thickness of asphalt is used so that a 3-in. brick pavement may be laid if desired in the future. The third class of paving is used in high-class residence districts and consists of 2 in. of asphaltic concrete on a 6-in. base of 1:2½:5 concrete. The fourth type of pavement, used in the poorer residential districts, is concrete 6 in. thick of a 1:3:6 mix. An 8-in. gutter is laid to permit resurfacing with 2 in. of asphalt in the future.

Many miles of old macadam streets were laid in the city in the past. These were excellently constructed of large angular rocks carefully laid by hand and make a pavement 12 to 18 in. thick. The city is placing a mat of ¼ to ½ in. of heavy road oil and sand on these streets and providing an excellent riding surface at small cost.

Crushed limestone is mostly used for large aggregate

Of the Small City

although Joplin chat is substituted to a certain extent. Missouri River sand is used for rough work but contains too much lignite for finishing concrete; Kansas River sand is used for the latter.

The city runs its own asphalt plant for repair work. There are two commercial plants in the city. The city plant has a capacity of 500 sq.yd. of 2-in. asphalt per day. The city engineer designed and built the plant which is very compact and, from an operating standpoint, is practically a one-man plant. A 30-hp. electric motor drives all of the equipment through a system of line shafts and clutches. Oil is burned as fuel since coal is too expensive on an intermittent plant. The procedure is for several men from the street repair gang to come to the plant in the morning to heat the sand and asphalt. These men can then be released for duty on the streets, one or two men handling the plant for the rest of the day. Asphalt patching is charged to the property owner. The city does all of the work taking charge immediately after the dirt is replaced in the hole. The superintendent of streets has charge of this plant and the repair work acting under supervision of the city engineer. Street cleaning, also under the direction of the superintendent of streets, is done by flushers. The town is so hilly that there is no necessity for sweepers.

Water Supply—Water is provided by a private company getting its supply from the Missouri River. Gravity sand filters, following settling and lime treatment, prepare the water for use. It is pumped to a reservoir on a hill 100 ft. above the highest point in the city and distributed by gravity.

Sewage—New sewer construction aggregating $800,000 was done in the city in 1925, all under the direction of the city engineer. All sewer work as well as other construction is contracted. Plain concrete is used exclusively on new sewers. All sewers are combined. The very steep grades provide a problem in design and construction. The latter, however, is aided by the geological substructure which is largely loess. The sewage is discharged raw into the river where the large amount of sand and sediment destroys all bad effects before Atchison, Kansas, the next town down the river is reached.

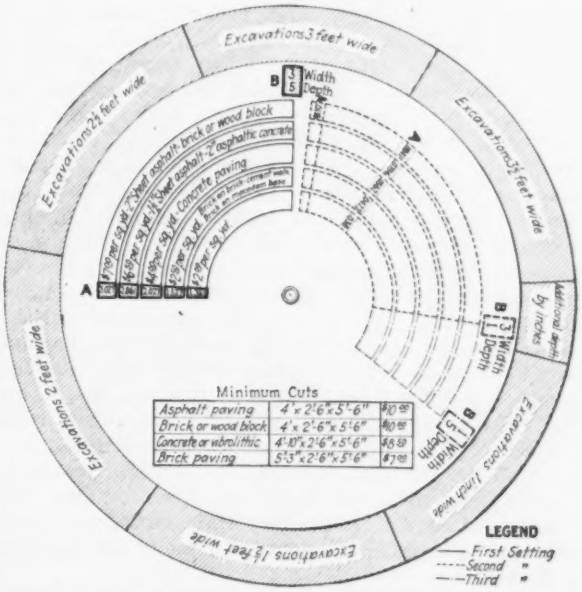
Quick Computation of Paving Cut Costs

By Ralph B. Slippy
City Engineer, Waterloo, Iowa

EXCAVATIONS in pavements for repairing and extending subsurface structures are always a source of trouble to the municipal engineer. It is difficult to get such excavations properly filled. If left to the plumber or other workmen, it is likely to be carelessly done, and subsequent trouble is liable to be expensive and destructive.

Waterloo, Iowa, has attained a practice which may prove profitable elsewhere. When a new street is just paved, every effort is made to see that subsurface installations are made to supply the needs of the territory served during the life of the pavement. The property owners are first notified to make the connections and in cases where the property owner does not comply the work is done and the cost assessed against him. In order to make the orders of the engineer more effective the ordinance provides that no cuts can be made in new paving within two years after the improvement is completed, except to repair breaks in the mains. If cuts are made in the pavement for any purpose within five years after the pavement is completed, the charge made by the city for making the repairs is double the required amount.

After completing the work required, the street commissioner is notified. He then fills the hole and puts on a temporary covering of brick block. These holes are looked after by the street department until such a time as it is convenient to make a permanent repair. The street commissioner notifies the city engineer as to the exact measurements and a report is made to the city clerk monthly, showing the permit number, location, amount of deposits, amount of refund or additional charge as the case may be.



SLIDE RULE FOR CALCULATING PAVEMENT CUT COSTS

To illustrate the method of working the slide rule, take for example an excavation of 3 ft. 1 in. wide, 5 ft. 1 in. deep and 5 ft. long, in asphalt paving at $7 per sq.yd. To ascertain the proper charge, scale "B" is set first so that on the large circle it will read 3 ft. wide and 5 ft. deep. Reading on scale "A" which gives charges for various types of paving, under $7, the price is found to be $3.027 per lin.ft. Turning in the same way to the excavation 1 in. wide and 5 ft. deep, we find the cost is $0.0841. Turning again to the 1 in. additional depth 3 ft wide, we find the cost is $0.0116 per lin.ft. Adding these three we have $3.1227, cost of excavation per lineal foot. Multiplying by 5 we get $15.61, total cost.

In order to facilitate the computation, a circular slide rule was devised by William J. Grobe of the city engineer's office. The large circle is figured in prices per lineal foot for excavations 1 in., 1½ ft., 2 ft., 2½ ft., 3 ft., and 3½ ft. wide for depths from 2 to 9 ft., giving the price for each half foot in depth. There is also a figure given for the same widths of ditch for 1 in. additional depth. The prices for cuts covering this wide range of width and depth are arranged in concentric circles. Each circle represents the cost of cutting into a different pavement. The concentric circles, then, show costs per lineal foot of cutting on the basis of $7, $6.50, $4, $2.50 and $2 per square yard, depending on the type of surfacing. The minimum charge for various kinds of paving is shown on the rule under minimum costs.

Toledo Intercepting Sewer System—Basis for Design

Progressive Construction Program Laid Down After Comprehensive Investigation—Design for Ultimate Population and Area Expected in 1960

By Harvey P. Jones
With Fuller & McClintock, Engineers, New York and Toledo

REMOVAL of sewage pollution from Ten Mile Creek, Swan Creek and most of it from the upper reaches of the Maumee River at Toledo, Ohio, has been accomplished this year by the completion of the construction carried on since July, 1920. Abatement of nuisances caused by sewage pollution of these two small water courses is a problem which has confronted all city administrations for more than two decades and the solution of the problem itself has taken nearly ten years. Definite orders to correct the existing nuisance in Ten Mile and Swan Creeks were issued to the city of Toledo by the State Department of Health in 1913. Up to the present time a large portion of the sewage has been disposed of by dilution in the Maumee River, without causing noticeable pollution except in limited areas in shallow water in the immediate vicinity of some of the larger sewer outlets. Preliminary investigations, which included sewer gagings, census studies, measurement of stream flows, sanitary surveys, classification of water consumption, surveys, test borings and the like, were made by the city in 1916. A bond issue of $2,800,000 was passed at the general election in 1917 and in 1919 detail plans for the system were completed. On completion of the work now under contract all the conditions specifically named in the State Health Department orders will have been corrected and the basis of a system of sanitary drainage will have been provided to care for the needs of the city for the next forty years.

Maumee River divides the city into two parts and has a drainage area of about 6,800 sq. miles. The water supply is taken from this stream at a point about 9 miles from its mouth, and is filtered. The lower stretches of the river on both sides are given over to industrial and commercial establishments. A high-class residential development extends along both sides of the upper reaches as far as the villages of Maumee and Perrysburg. Swan Creek discharges into Maumee River just above the business district, while Ten Mile Creek discharges directly into Lake Erie. The flow in these streams is small; in fact sewer and stream flow measurements indicated that the volume of polluting matter was 25 to 50 times the dry-weather flow. Sanitary surveys showed that large volumes of sewage can be satisfactorily disposed of by dilution in the Maumee River, provided precautions are taken to disperse the sewage into deep water at a point near the mouth of the river where full advantage can be taken of the diluting effect of Lake Erie. Water surface elevations in the Maumee River are subject to considerable fluctuation due to changes in stage of Lake Erie. Strong west winds cause decided drops. Northeast winds produce opposite results. Variations of 8 to 10 ft. between maximum and minimum levels, due to wind, are yearly occurrences. Back-water flows of two miles or more are not infrequent and the water in the lower stretches is subject to frequent change. In the shallow water close to the river banks the velocity is always slight and at times is actually upstream. When strong west winds occur, 100 to 150-ft. of river bottom is frequently exposed. Under these conditions the solid materials in the sewage are deposited in the immediate vicinity of the outlets and remain there. Similar results are produced on the stream beds of both Swan Creek and Ten Mile Creek.

While it is true that conditions in the vicinity of the existing outlets to the river are not particularly offensive, still they are sources of potential nuisance. The general plan as laid out provided for the removal of

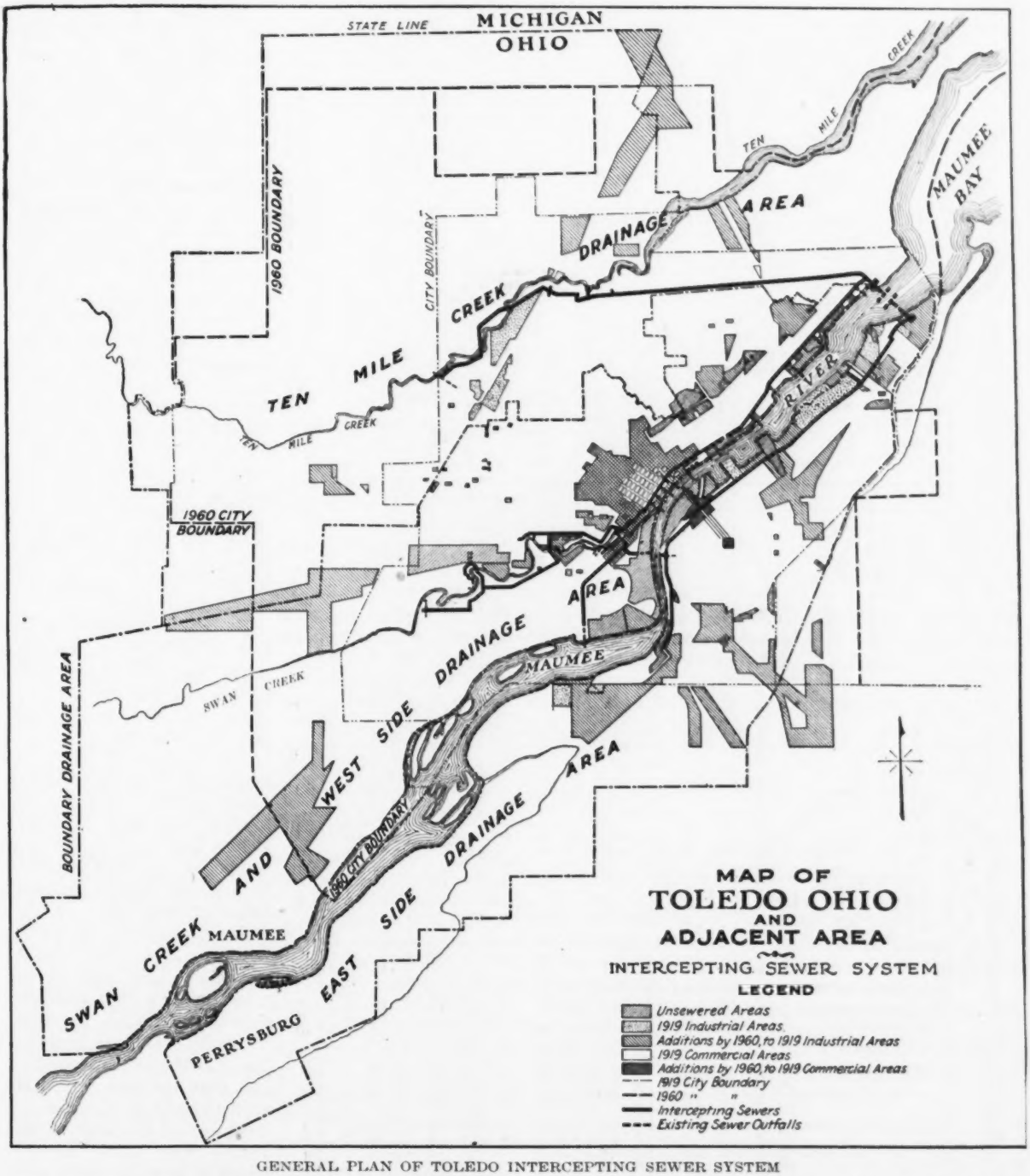
TABLE I—PRESENT AND ESTIMATED 1960 AREA AND POPULATION

Drainage Area	Present Population	Present Area Acres	1960 Population	1960 Area, Acres
Ten Mile Creek	60,000	4,000	310,000	20,000
Swan Creek	75,000	4,000	194,000	13,000
West Side River	75,000	4,000	111,000	4,000
East Side River	40,000	4,000	165,000	10,500
Totals	250,000	16,000	780,000	47,500

TABLE II—RELATIONS OF INDUSTRIAL, COMMERCIAL AND DOMESTIC FLOWS FOR VARIOUS CITIES (Design Basis)

	Toledo	Milwaukee	Detroit	Buffalo	Cincinnati	Louisville	Fitchburg
Date of ultimate estimate	1960	1950	1940	1950	1950	.....	1940
Population	781,900	862,000	1,500,000	800,000	720,000	230,000	87,200
Industrial area, acres	4,139.05	3,762	4,800	4,065	8,180	622	1,256
Commercial area, acres	837.60	84	700	568	723	66	.....
Industrial, g.a.d.*							
Ave., used in design	8,000	9,350	8,000	.....	4,500	.....	4,444
Max., used in design	12,000	16,800	12,000	16,000	9,000	24,000	8,000
Commercial g.a.d.*							
Ave., used in design	15,000	17,700	33,000	.....	.....	.....	.....
Max., used in design	30,000	29,800	50,000	60,000	40,000	30,000	.....
Industrial g. per 1,000 pop.							
Ave.	42,340	40,900	25,600	.....	51,000	.....	66,800
Max.	63,510	73,400	38,400	81,500	102,000	.....	115,650
Commercial g. per 1,000 pop.							
Ave.	16,060	17,400	15,400	.....	.....	.....	.....
Max.	32,120	29,200	23,400	42,600	40,100	8,160	.....
Ground water g.a.d.*							
Ave.	600	1,660	.....	.....	750	.....	.....
Max.	800	1,660	500–1,000	1,000–1,850	750	1,960	.....
Domestic gal. per cap.							
Ave. for year	52	50	.....	.....	.....	.....	.....
Ave., max. days	65	50	114	.....	86	100	75
Max. rate	113**–158**	125	228	285	135	200	150

* G. a. d. = Gallons per acre daily.
** Maximum rate depends on population of drainage area.



GENERAL PLAN OF TOLEDO INTERCEPTING SEWER SYSTEM

these sources of future nuisance, the correction of conditions in Swan Creek and Ten Mile Creek and the utilization to the fullest extent of the diluting effect of Maumee River as a means of sewage disposal.

General Plan—In formulating the general plan it was the aim of the engineers effectively to correct the conditions complained of and at the same time adequately to provide for the needs of the future. The initial outlay has been kept at a minimum through a piece-meal program of procedure which calls for the construction of units, other than those immediately necessary, and only when the need for them becomes apparent.

In the general plan for the collection of all the sewage, intercepting sewers are contemplated following, in general, the courses of streams to pumping stations on each side of the river near its mouth. Pumping stations must be provided to raise the sewage from the intercepting sewers to a point from which it can be dispersed into the river through submerged outlets. This is the method to be followed in the immediate future. Later these pumping stations will discharge the sewage to treatment works.

The accompanying map shows the location of the main intercepting sewers, the boundaries of the various drainage districts and the extent of territory ultimately served by the entire system.

Table IV—Relation of Domestic, Industrial and Commercial Sewage Flows and Ground Water Allowances Used as Bases of Design of Intercepting Sewers

City	Date of Design	Date of Ultimate Estimate	Area	Population	Future Density	Water Supply g.c.d.* as of Date of Design		Domestic Sewage as g.c.d.* as of Date of Ultimate Estimate				Industrial Sewage				Commercial Sewage				Ground Water			
						Domestic	Total	Ave. Daily Normal Conditions	Ave. Daily Extreme Conditions	Max. Rate	Per Cent Max. Rate is of Normal	Average Rate g.a.d.**	Maximum Rate g.a.d.**	Total Average Flow g.c.d.*	Total Maximum Flow g.c.d.*	Average Rate g.a.d.**	Maximum Rate g.a.d.**	Total Average Flow g.c.d.*	Total Maximum Flow g.c.d.*	Ratio Max. to Average, Per Cent	Average Rate g.a.d.**	Maximum Rate g.a.d.**	Average per Mile of Sewer	Maximum per Mile of Sewer	Total Average Flow g.c.d.*	Total Maximum Flow g.c.d.*
1. Milwaukee	1910	1950	37,790	862,000	22.8	33	98	50	...	125	250	9,350	16,800	36.0	65.0	17,700	29,800	20.0	33.0	170	1,200	1,620	.....	.....	47.5	64.0
2. Detroit	1915	1940	74,500	1,500,000	20.1	110	169	114	...	228	200	8,000	12,000	25.6	38.4	33,000	50,000	15.4	23.4	152	.....	500 1,000	.....	18,000 36,000	.....	.....
3. Buffalo	1915	1950	24,928	800,000	32.0	81	324	.....	.....	285	.....	.....	13,000 16,000	.....	90.8	.....	60,000	.....	46.6	.....	.....	1,000 1,850	.....	25,000 100,000	.....	31.4
4. Cincinnati	1913	1950	82,697	711,810	8.6	80–92	131	90	.....	135	150	4,500	9,000	51.8	103.5	200	40,000	.....	40.5	.....	.....	750	.....	.....	.....	87.0
a. Mill Creek	1913	1950	52,740	308,664	5.9	.....	.....	90	.....	135	150	4,500	9,000	71.5	143.0	200	.....	.....	.....	.....	.....	750	.....	.....	.....	128.0
b. Ohio River	1913	1950	17,266	303,826	17.6	.....	.....	90	.....	135	150	4,500	9,000	31.0	62.0	200	40,000	.....	95.0	.....	.....	750	.....	.....	.....	42.6
c. Duck Creek	1913	1950	12,691	99,320	7.8	.....	.....	90	.....	135	150	4,500	9,000	55.5	111.0	200	.....	.....	.....	.....	.....	750	.....	.....	.....	96.0
5. Louisville (Beargrass Creek)	1905	.....	7.82^	230,000	29.4	.....	.....	100	.....	200	200	.....	24,000	.....	65.0	.....	30,000	.....	8.6	.....	.....	1,960	.....	.....	.....	66.6
6. Fitchburg	1911	1940	8,134	87,200	10.7	.....	.....	75	.....	150	200	4,444	8,000	64.0	115.0	180	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7. Toledo	1919	1960	47,300	781,900	16.6	34	92	52	65	118	227	8,000	12,000	42.5	63.5	150	15,000	30,000	16.0	32.0	200	.....	.....	22,000 to 30,000	29,000 to 48,000	28.5	38.0
a. Ten Mile Creek	1919	1960	19,930	312,870	15.7	34	92	52	65	114	220	8,000	12,000	23.2	34.8	150	No. Area	.....	.....	.....	.....	600	800	26,000 to 37,000	34,000 to 48,000	37.0	49.0
b. W. Side & Swan Creek	1919	1960	16,873	304,760	18.1	34	92	52	65	113	218	8,000	12,000	37.6	56.5	150	15,000	30,000	37.5	75.0	200	600	800	22,000 to 30,000	29,000 to 39,000	21.0	27.6
c. East Side	1919	1960	10,498	164,270	15.7	34	92	52	65	125	240	8,000	12,000	87.6	131.3	150	15,000	30,000	7.0	14.1	200	600	800	25,000 to 30,000	28,000 to 29,000	26.5	35.4
*d. W. S. Up-River Area	1919	1960	9,037	60,000	6.6	.....	.....	52	65	146	281	8,000	12,000	90.0	135.0	150	No. Area	.....	.....	.....	.....	260	320	26,000	32,000	36.0	48.0
*e. E. S. Up-River Area	1919	1960	5,968	50,000	8.4	.....	.....	52	65	150	288	8,000	12,000	83.5	125.0	150	No. Area	.....	.....	.....	.....	333	410	26,000	32,000	37.0	49.0

* g.c.d. = gallons per capita daily. ** g.a.d. = gallons per acre daily.
* 7d. Included in future West Side and Swan Creek drainage area.
** 7e. Included in future East Side drainage area.

The following notes apply to Ground Water:
1. Very old sewers.
2. 500 g.a.d. for clay sections, 1,000 g.a.d. sandy sections.
3. Sand and clay sections.
4. Clay soil. 7. Tight blue clay soil.

The East Side intercepting sewer and the East Side pumping station have not been put under contract as yet. The relatively small volume of sewage from this area can be disposed of for some time without difficulty by continuing to discharge it into the river through the existing outlets. The territory to be served by the East Side interceptor is limited in an easterly direction by reason of the fact that existing sewers can not be extended beyond the east city limits because of the low areas in the valleys of Duck Creek and Otter Creek. At some time in the near future, intercepting sewers will be required east of the east city limits in the Duck Creek and Otter Creek Valleys, to provide adequate facilities for this rapidly developing territory.

No definite program as to type or location of sewage-works was laid out, because of lack of funds and because proper dispersion in the river is sufficient.

Population and Area—A careful study of the probable future growth of the city led to the conclusion that by 1960 a population of 700,000 would be resident on the 33,000 acres within the city limits of that date. In addition to territory included in the 1960 city limits provision also has been made for such areas adjacent thereto as could be economically served. In general, the distribution of population over the area served is such as may be expected in 1960, except in cases where future relief is not readily possible, in which cases provision has been made for all probable future development.

A large part of the area within the present city limits is served by combined sewers. In portions of the drainage areas which are not now sewered, separate sewers will be built in the future. Of the ultimate area of the drainage districts 88, 61 and 54 per cent of the Ten Mile Creek, East Side and

TABLE III—RELATIONS OF INDUSTRIAL AND COMMERCIAL AREAS TO TOTAL POPULATION AND TOTAL AREA OF DATES OF DESIGN AND ULTIMATE ESTIMATES, FOR VARIOUS CITIES

	Toledo	Milwaukee	Detroit	Buffalo	Cincinnati	Louisville Bear Grass	Louisville Creek	Fitchburg
Date of design	1919	1910	1915	1915	1913	1906		1911
Date of ultimate estimate	1960	1950	1940	1950	1950	.....		1940
Population								
Date of design	254,700	414,000	768,746	.....	402,000	230,000		37,320
Date of ultimate estimate	781,900	862,000	1,500,000	800,000	720,000	230,000		87,200
Ultimate population per acre	16.6	22.8	20.1	32.0	8.0	29.5		10.7
Area, acres**								
Date of design	15,945.00	16,400	30,200	.....	44,800	.....		.....
Date of ultimate estimate	47,299.80	37,790	74,500	24,928	89,600	7,829		8,134
Industrial area, acres								
Date of design	807.10	1,670	.....	.....	.....	.....		.....
Date of ultimate estimate*	4,139.05	3,762	4,800	4,065	8,180	622		1,256
Commercial area								
Date of design	137.30	281	.....	.....	.....	.....		.....
Date of ultimate estimate	837.60	847	700	568	723	66		.....
Industrial per 1,000 population								
Date of design	3.17	4.04	.....	.....	.....	.....		.....
Date of ultimate estimate	5.30	4.36	3.20	5.08	11.40	2.70		14.4
Commerical per 1,000 population								
Date of design	0.54	0.68	.....	.....	.....	.....		.....
Date of ultimate estimate	1.07	0.98	0.47	0.71	1.10	2.90		.....
Per cent industrial is of total								
Date of design	5.06	10.2	.....	.....	.....	.....		.....
Date of ultimate estimate	8.76	10.0	6.0	16.3	9.1	8.0		15.4
Per cent commercial is of total								
Date of design	0.86	1.70	.....	.....	.....	.....		.....
Date of ultimate estimate	1.77	2.24	0.94	2.28	0.80	0.85		.....

Note—Data on which above table is based is found in the Milwaukee Report for 1915, Cincinnati Report for 1913, Buffalo Report for 1915, Detroit Report for 1915, Louisville for 1910, Ten Mile Creek West Side, and East Side River Investigations, Toledo, Ohio, 1916–1918, Fitchburg Report for 1911.

* Including 341.00 acres, industrial area, not in drainage area.

** All areas are in acres.

West Side and Swan Creek districts, respectively, will be sewered on the separate plan. Careful studies were made to determine the probable future location and extent of industrial and commercial areas, and gagings and measurements of water consumption were made from which conclusions were drawn as to the probable future rates of discharge of sewage from each of these classes of areas.

Unit Rate of Flow—Domestic sewage rates of flow in gallons per capita daily for the future were determined after sewer gagings had been made in typical residential areas. Pitometer survey measurements in certain classes of districts were utilized together with data obtained as to the consumption of water for domestic purposes from the records in the water department.

From these sources of information the conclusion was drawn that the future average daily per capita discharge of domestic sewage, throughout the year, would be 52 gal. which figure allowed for a more universal use of plumbing facilities as well as a tendency for larger use of water. The future average daily discharge, on maximum days, it was concluded would be 65 gal. While these figures represent the average daily flow, the maximum hourly rates, used in determining the total maximum flow, were assumed to vary according to the total population tributary at any particular point in the system. The ratios of the maximum hourly rate to the average daily rate on the day of maximum, for various populations, are given in the following tabulation:

Total Population Tributary	Ratio Max. Hourly Rate to Average Daily Rate	Total Population Tributary	Ratio Max. Hourly Rate to Average Daily Rate
25,000	2.45	200,000	1.87
50,000	2.30	250,000	1.80
100,000	2.10	300,000	1.75
150,000	1.96	400,000	1.70

Industrial and commercial average daily rates of flow in the future were estimated to be 8,000 and 15,000 gal. per acre daily respectively, and the maximum hourly rates of flow 12,000 and 30,000 gal. per acre daily.

Ground water infiltration into existing city sewers was estimated to be 600 gal. per acre daily, as an average throughout the year and 800 gal. per acre daily during wet seasons. For territory not now sewered, but in which small pipe sewers would be constructed with bituminous joints, smaller ground water allowances were made. These allowances were taken at 26,000 gal. per mile of sewer under maximum wet-weather conditions.

Storm water allowances sufficient to take care of the first flush of storm water were made because the existing combined sewers have been laid at grades so flat as to cause deposits in them at dry-weather periods. In districts tributary to Ten Mile Creek and Swan Creek storm water an allowance equivalent to the run-off from rains of an intensity not exceeding 0.02 in. of rainfall per hour were allowed. The run-off from residential and densely built-up areas was taken at 30 and 70 per cent respectively. For districts tributary to the Maumee River no storm water allowances were made for the first flush of storm water on account of the much larger diluting factor of this stream.

Tables II, III and IV show the ultimate population tributary, the future industrial and commercial area and the unit rates of flow, used in the design of the Toledo intercepting sewer system and a comparison with those used in other cities on similar work.

Preliminary investigations were conducted by a special department under the direction of David H. Goodwillie, director of public service, and Harry C. McClure, city engineer. Designs and plans were made by Fuller & McClintock, New York City.

Protracted Rain Not Considered "Act of God"

Forty days of rain out of 60 cannot be termed "an act of God" in a government contract, according to Comptroller General McCarl, who has refused a $475 refund to the Cunningham Construction Co., holding a contract for the erection of barracks at Langley Field, Va. The company was penalized for a 31-day delay in completing the work and appealed to the comptroller general, blaming the delay on 40 days rain in two months, and citing, as possible relief, the "acts of God" clause of the contract. The comptroller decided that the protracted rain was a "common, natural event," and a hazard assumed by the contractor.

Difficult Underpinning Work in Building Reconstruction

Putting in Sub-basement in Philadelphia Department Store Involves Unusual Difficulties—Quick Hardening Cement Used

By William P. Parker
Consulting Structural Engineer, Philadelphia, Pa.

Enlargement of the Frank & Seder department store at 11th and Market Sts., Philadelphia, recently completed, included replacing a group of small buildings by an entirely new structure, rebuilding part of a more modern building, and putting in a basement and sub-basement under the latter building. This was done to secure sales room easy of access from the Market St. subway recently constructed. Building the basements was done without interference to business on the floors above. The underpinning, therefore, was a major part of the work.

The center of particular interest in the reconstruction

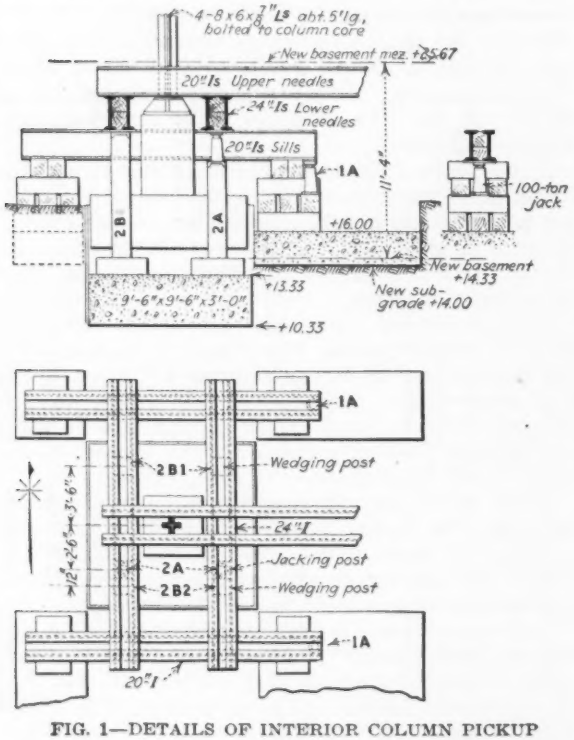


FIG. 1—DETAILS OF INTERIOR COLUMN PICKUP

work was the Stecker Building, where the new basement and sub-basement were put in. The building has five rows of columns of six columns each, 18 being wall and 12 interior columns. The interior columns presented the greatest difficulty. They were jacked up, the old foundations removed, a pit sunk to the new and lower foundation level, new foundations built in the pit, and the column loads transferred to the new foundations. The work was laid out in such a way that while construction was being carried out on a particular column, the four columns immediately north, south, east, and west of it either had not been disturbed or had been completely underpinned.

As a preliminary, the column loads were calculated rather carefully, in order that the jacking arrangements could be fitted to them. The loads were found to be lower than the building-code loadings by variable amounts, and ranged from 260 to 340 tons, while the design loads ran as high as 401 tons.

Work was started on the north and west walls, underpinning the wall between the columns and then carrying down alternate wall-column footings. At the same time excavation was started on the west side and carried down to within 1 ft. of the underside of the existing interior-column footings; excavating below this level might result in settlement, it was thought. As the excavation advanced we were able to start on four interior columns while still working on the first four wall columns. Yet each of the eight columns was surrounded by undisturbed columns, as mentioned above. When the four wall columns were completed, the intermediate wall columns were started, and similarly for the interior columns.

Underpinning the Wall Columns—Wall columns were carried down by means of pits undermining one half of a column at a time. The old footing was posted up with 6x6-in. timbers as fast as it was undermined. Four timbers were used under half of the footing, with sill blocks below and wedges on top. Reinforcing rods were placed, a portion of them being driven into the soil under the undisturbed half of the footing, so as later to form a lap splice with the rods under the other half of the footing. This first half footing was filled with 1:2:4 concrete to within about 3 in. of the underside of the old footing and allowed to stand 24 hours. "Dry packing," consisting of one part sand and one part alumina cement, barely moistened with water, was then put in between the old and new work. This dry packing was tightly rammed in small quantities so that all irregularities of surface of both old and new work were thoroughly filled. The new concrete footing had set up and shrunk before the dry packing was placed, and the latter does not shrink in setting, but swells slightly, picking up the column load. This method in practice is much more satisfactory than that of using steel plates and wedges for sealing masonry underpinning. Care was taken that no portion of the new footing above the sub-basement level extended beyond the face of the column pilaster on account of the high value of the floor area as selling space. After the above work was 24 hours old the remaining half of the footing was underpinned in a similar manner. Later the projecting portion of the old footing was cut off flush with the face of the pilaster for room clearance.

Procedure at Interior Columns—The interior columns were carried on sills, needles and hydraulic rams, as shown by sketch herewith. As the soil was treacherous it was found necessary to bed the sills at the corners of the old footings, the cribs resting on temporary concrete footings 2 ft. thick. These footings were cast in pits excavated to sub-basement subgrade (El. +14.0) and the top of the concrete was carried to El. +16.0, generally about 1 ft. above the underside of the old column footing. The sills and needles were designed to carry the actual column loads with stresses 50 per cent in excess of the customary standard. The sills were pairs of 20-in. I's bolted together with two 10x12-in. timbers between. The lower needles were pairs of 24-in. I's bolted together with two 12x12-in. timbers between. Considering the rough treatment these sills and needles received they stood up very well, and the filling timbers effectively supported the web and flange of the beams under the concentrated load.

The upper needles were two 20-in. I's, straddling the column. These upper needles later became a permanent part of the new basement floor. They connected two columns and extended 4 ft. beyond the column center at each end.

The old columns comprised a structural-steel core made of four 6x6x⅜-in. angles and four bars 4x⅞ in., assembled back to back to form a cross-shaped section; concrete encasement 18 in. in diameter; and reinforcing rods consisting of four ½-in. square vertical rods and ¼-in. hoops spaced 12 in. The columns rested on cast-iron bases 16 in. square on top and 32 in. on bottom, by 12½ in. high. To transfer the column load to the needles, four 8x6x⅜-in. angles 5 ft. long were bolted to the core angles, with outstanding legs turned out, in such position that their lower ends rested directly on the top flanges of the upper needles. The angles were attached to the columns during the time the outside wall was being underpinned and the temporary footings cast, the columns being taken in hand in the order in which they were later to be underpinned. The 18-in. concrete shaft was cut off on the south half of a column for the necessary height, the structural steel core drilled, and two of the 8x6-in. angles attached with turned bolts; then, the column being strengthened by the addition of these angles, the remaining half of the

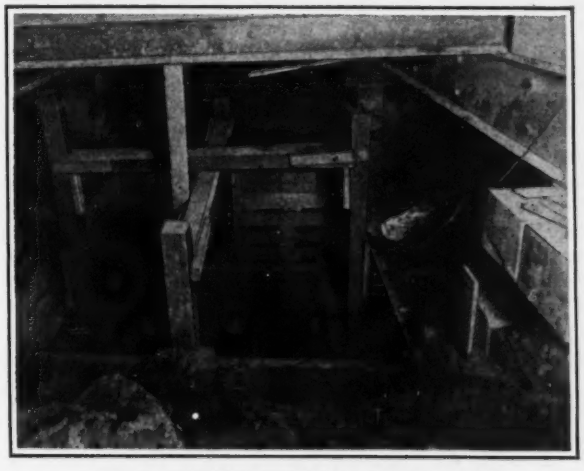


FIG. 2—SINKING PIT FOR NEW FOOTING

concrete encasement was chipped off and the second pair of angles attached.

So that the permanent needles could be placed independently and in advance of the column pick-ups, short horizontal 3x2½-in. angles were placed at the lower ends of the 8x6-in. angles for a connection to the top flanges of the upper needles. In this way the upper needles could be suspended from the columns. In fact these needles as well as steel beams for the basement floor were placed concurrently with the underpinning, and by the time the underpinning was completed all basement floor steel was in place and over 80 per cent of this floor concreted.

Underpinning of these interior columns was started as soon as the basement excavation was sufficiently advanced and the first few temporary footings cast. The location of these temporary footings and the general procedure in the underpinning may be understood from the adjoining sketch, together with a brief explanation.

Timber cribs were placed on the temporary footings, and the sills and lower needles assembled. On the crib over the larger temporary footing a 100-ton hydraulic jack was set, and 12x21-in. steel plates of various thicknesses and steel wedges 2½x½x12 in. were provided for wedging up between sills and crib. First, the end of the sill away from the jack was wedged up, working alternately on first one timber and then the other, using six wedges at each point and placing as many plates as necessary. After this end of the sill was well wedged,

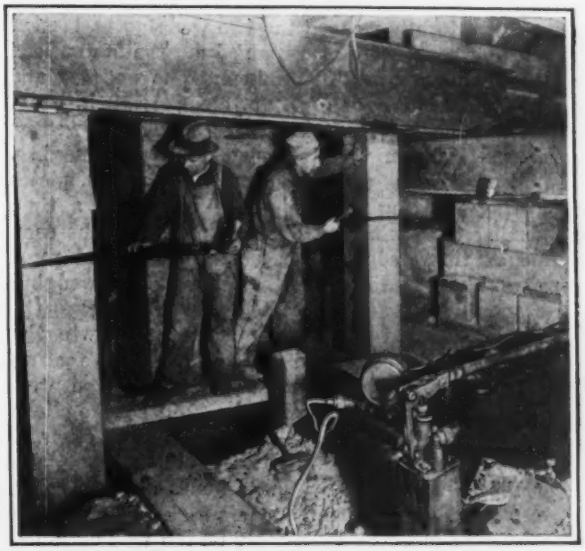


FIG. 3—SAWING OUT WEDGING POSTS

the jack at the opposite end was pumped up to a load of 50 tons, and shim plates and wedges were put in place as fast as the sill was lifted. The final driving of these wedges probably made an added pick-up of 15 tons above the jack load, or a total of 65 tons, giving a total lift of 260 tons on the column. This completed the first pick-up. The alternate arrangement of work, which was adopted for safety (each column on which work was progressing being surrounded by columns not yet begun or else completed) also gave room for setting up sills and needles without interference between the different working columns.

After the first pick up the old concrete footing was cut away and removed. The work was done with plug-and-feathers in holes drilled with jackhammers. The concrete was tough and filled with small reinforcing rods. These rods were never in the same place in any two footings. Whenever the drill struck a rod the drilling had to be started over again elsewhere.

A pit was sunk for the new footing. Horizontal pit boards were placed as the excavation was carried down. Particular care was taken to loosen no soil so as not to undermine the temporary footings at the corners of the pit. These temporary footings were then carrying the full load of the column. The louvers in the pit boards permitted tamping and grouting back of the boards, yet the bevel of the louver is such that the soil stops at its natural slope and cannot flow out into the pit. Eight boards were used to a ring and a frame of four 6x6's was used to support their ends, the frame being driven down as the pit excavation progressed. After excavation of the pit was complete, the corner posts were placed, horizontal 6x6 rangers set in and the cross struts removed.

The new footing was cast of 1:2:4 alumina cement concrete. When the concrete was 24 hours old and before the plinth was cast, wedging and jacking posts were placed between the new footings and the lower needles. Wedging posts on sill blocks were placed near either end of the needles, and jacking posts close to the wedging posts at one end. A load of 56 tons each was placed on the two jacking posts, and steel wedges were driven at the contact point between the sills and lower needles on the side nearest the jacks. After the points were tightly wedged the two wedging posts next the jacking posts were also wedged up, the 56-ton load on the rams being still maintained. The wedging and jacking posts had caps of 12-in. channels 12 in. long, while 6x12-in. and 12x12-in. plates with steel wedges were used between wedging posts and lower needles. Eight wedges were used to a post, the 6x12-in. plates permitting wedging of one-half of a post at a time and taking the spring out of the plates. On the completion of this wedging the jacking posts and rams were moved over adjacent to the other pair of wedging posts and the operation repeated. By this means the column load was transferred almost entirely to the new footing and compressed the soil under the footing before placing the column on it to prevent settlement.

The forms and reinforcing for the 40-in. square plinth were then placed and 1:2:4 alumina cement concrete cast to within 2 to 3 in. of the cast column base plate. After the plinth concrete was 24 hours old, the space between it and the column base was sealed by ramming dry packing similar to the sealing of the wall columns. This was done while the new footing and column were being held apart by the wedging posts with a force of from 250 to 260 tons. The forms of the plinth were then carried on up and an additional short section of plinth concreted, completely enclosing the cast-iron base with its seal and extending 3 in. above the lower flanges of the upper needles.

Arrangements could have been made to lower the wedging posts by miter blocks or sand boxes, but in either case the posts might have been lowered prematurely through careless inspection. The posts were removed by sawing them through at an angle of 45 deg. Eight men and four crosscut saws were used. The men sawed from the outside of the posts at a downward angle. After the removal of the wedging posts the jacks were placed back on the cribs under the sills, and a load of 65 tons placed on each jack, whereupon the wedges and plates between sill and crib nearest the jack were driven out. The lowering of the load on the jacks allowed the sills to settle until the lower needles were free from the upper needles, thus taking all the load from the sill-needle set-up to the new footing.

During the entire procedure a record of elevations of columns and possible settlement was kept. The movements were so slight that it was not possible to do satisfactory work with a level rod. With a given height of instrument a center-punch mark was placed on the steel core of a column before the latter had been disturbed, and this line was transferred directly to a mark on the outside building wall. After each operation on a column the level was again set up and with a card held with a mark on the center punch mark on the column a new H. I. was put on the cards. The card was then placed on the wall; the new H. I. brought into line of sight and position of the wall mark transferred to card. The distance between these two marks showed the actual movement of the column. These marks were often on top of each other and it required care with a chisel-pointed drawing pencil to mark the record. The columns were sometimes raised slightly on the first and second pick-up, but the maximum total movement of any one column was less than one-sixteenth inch.

The Ballinger Co. were architects for the building, with W. E. Snaman of Pittsburgh as associate architect. Percival M. Sax, consulting engineer for the owner, was in direct charge of the work, the architects also having a representative in the field. The Underpinning & Foundation Co., Inc., of New York, were contractors for the foundations and the writer was consulting engineer for them.

Construction in the British Empire

London Correspondence

THERE is very little constructional activity of any importance under way now in Britain, due very largely to the unsettled conditions in the coal mining industry. Until the government subsidy expires, in May, when the future of the industry will be determined to a large extent, few British concerns are undertaking any works of exceptional interest.

The most important works under way in England are the electrification of the London suburban railways and the extensions of the electric railway, or subway, system. Some 250 miles of the suburban lines on the south side of London are approaching conversion from steam to electric operation, and the Southern Ry. is engaged in enlarging its terminals to accommodate the increased traffic under electric service. This involves gradual conversion in the terminals without serious interference of the existing service, and the fact that three of the terminals are built on the river edge with bridge approaches across the river makes the work more costly and protracted. The Southern Ry. is also strengthening and reconstructing 17 railway bridges on a length of about 6 miles of line so as to accommodate the new class of heavy express locomotives used for continental train service.

The most important work in and around London is the extension of the subway system to Morden, about 12 miles out. The new route has involved 5 miles of track with 4½ miles of tunnel, 1,600 ft. of cut and cover and 800 ft. in the open. The work has been accomplished in about nine months, employing 4,000 men, ten rotary excavators, four Greathead shields, and six other Greathead shields for the wider excavations necessitated by the various stations. Sixty thousand tons of cast-iron sections have been used, and the extension has cost about 3½ millions sterling.

The Armstrong Whitworth Co. has signed an agreement with the sultan of Perak for the development of the hydro-electric scheme of Lower Perak, the largest industrial undertaking in the Malay Peninsula. A dam of the Ambursen type, 640 ft. long and 60 ft. high, is to be constructed, and the power is to be derived from two units, each with a capacity of 9,000 kw. Power will be supplied to the tin mines and other industries in the Peninsula. As the capacity of the turbines may fall during an average of one month in each year, owing to diminution of the water supply, an auxiliary steam-driven plant of 5,000-kw. capacity will be made available in two years' time. The dam will raise the level of the Perak River 50 or 60 ft., and is estimated to be complete in two years, at a cost of 2½ millions sterling.

Concrete Snow-Sheds Built on Unit Construction Plan

Fire Protection at Summit of Sierras on S. P. Main Line Justifies Departure from Standard Timber Design

AT SUMMIT, Calif., the highest point on the main line of the Southern Pacific R.R. in the Sierra Nevada Mountains, the double-tracking project has made it desirable to relocate a turn-table so that it would be readily accessible from either east- or west-bound tracks. In tracks adjoining this turntable there has been a departure from the standard timber design for snow-sheds and the substitution of all-concrete construction. The concrete sheds, completed late last fall, include about 240 ft. of double-track main line and a short length of the tracks leading to the adjoining turntable. About 38 single-track miles on this system in the Sierras are under timber snow-sheds, on which the standard construction was described in *Engineering News-Record*, Jan. 3, 1918, p. 44.

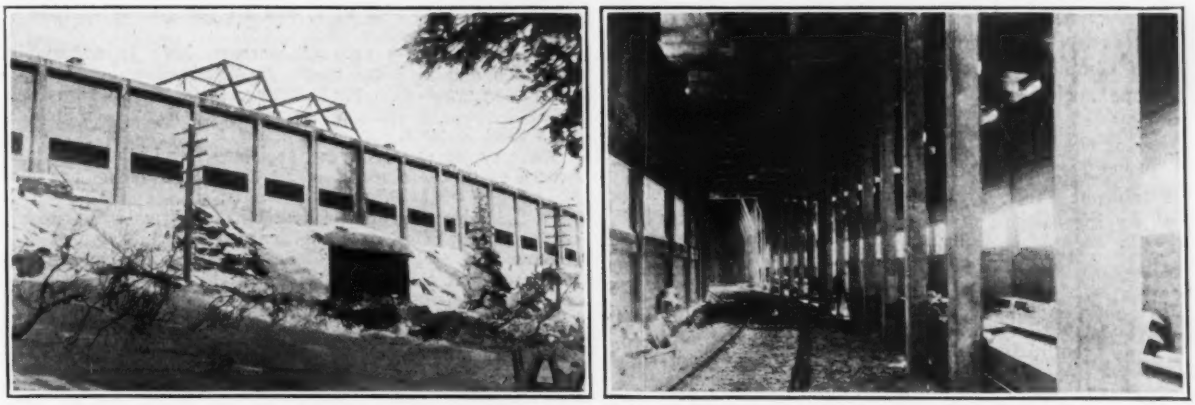
Despite the fire hazard and the heavy maintenance cost due to the decay of timber, thus far no other type of construction has been found practicable on account of the cost. To date only two concrete-shed jobs have been built; a short length where timber was not strong enough because of sliding mud, and the work at Summit described here.

The strategic importance of Summit makes it necessary to have a turntable there; conditions of topography require that the turntable be located close to the main line, and because of the heavy snowfall all tracks have to be under sheds. This combination of conditions brought a great concentration of timber structures at a point where fire would be particularly disastrous and it was decided to use concrete in short lengths of the shed over the four tracks approaching the turntable and on a length of the main line sufficient to give it adequate protection if the other sheds nearby should burn.

To avoid interference with the heavy traffic over this route the sheds were designed for construction on the unit system, all units being precast in a yard at Colfax, 51 miles to the west, the nearest point where suitable space and facilities were available. At Summit, too, the elevation is 7,017 while Colfax is at El. 2,417, thus making work in the late fall safer from freezing. Foundations were poured first and then unit by unit the sheds were set up, precast columns going up first and precast slabs with projecting reinforcing following to be inserted in grooves or against shoulders where grout could be used to tie the whole into a structure that would as nearly as possible approach the strength of monolithic concrete.

Foundations poured before the delivery of precast units were made of 1:3:6 concrete with a top finish of 1¼:2:4 mix. Footings for columns, instead of being the usual pedestal type, had hollowed tops into which the columns fitted, thus speeding up erection and giving stability to the support while grout was hardening.

In the double-track portion shown in the accompanying picture central columns 24 ft. 8 in. long were set up between the tracks, making it possible to use roof members much lighter than would have been required to span the double-track width. The clearance above rail head is 22 ft. and the clearance between supports is 16 ft. 7 in. The concrete structure is made up of bays, 16½ ft. long, and central and side columns are therefore on this spacing.



CONCRETE SNOW-SHEDS ON SOUTHERN PACIFIC MAIN LINE, AND AN INTERIOR VIEW
In the interior view, note smoke vents between roof and sides. Unit construction of roof and sides is apparent. Openings at sides are "windows" for benefit of passengers.

Side walls consist of precast columns and three precast slabs, the central slab including a 4x10-ft. "window" at the level of car windows. The precast roof slabs, supported on transverse beams that meet on the central columns, are inverted troughs, 6 ft. 3½ in. wide and 16½ ft. long. The side slabs have a panel thickness of 3½ in. Roof slabs have a panel thickness of 4 in. and a beam depth of 17 in.

The concrete mix used in slabs, beams and columns was 1¼:2:4. Weights of the more important precast units were as follows: Side slabs, 5,400 lb.; roof slabs up to 8,600 lb.; roof beams, 9,400 lb.; center columns, 7,900 lb.; side columns, 15,600 lb. Where converging tracks in the approach to the turntable made it impossible to continue the center columns a few concrete roof girders were made long enough to span from wall to wall. These were the largest precast units on the job and weighed about 25,500 lb.

The work was done under the general direction of W. H. Kirkbride, engineer, maintenance-of-way and structures, and W. F. Turner, division engineer, Sacramento division. Construction was under contract to W. A. Bechtel, San Francisco.

Second Highway Safety Conference Meets in Washington

Adopts Uniform Laws for Motor Vehicle Registration and Control and Submits Programs of Statistics Collection and Metropolitan Traffic Relief

APPROXIMATELY 1,200 men and women from all parts of the country attended the three-day session in Washington, March 23-25, of the second national conference on street and highway safety called by Secretary of Commerce Hoover. The first of these conferences, which met in December, 1924, adopted as the result of numerous committee studies a program of highway traffic relief which has had a considerable influence on the development of highway traffic practice and laws in all parts of the country. The second conference proceeded from the point where the first one left off. Last spring committees were appointed which have had numerous meetings and which presented to the current conference the results of their deliberations and their recommendations.

This conference was attended not only by members of these committees but by delegates of a number of national societies interested in automobiles and in traffic and by delegates specifically appointed by governors of most of the states.

The purposes of the two conferences have been given as follows: First, to focus public attention on the appalling increase in street and highway accidents, and, second, to develop a comprehensive program for improvement of traffic conditions and reduction of accidents upon which all concerned, including state and municipal officials and others interested, could agree. The six committees which have been working on the program were (1) uniformity of laws, rules and regulations, (2) enforcement, (3) causes of accidents, (4) metropolitan traffic facilities, (5) statistics, and (6) public relations.

The major part of the deliberations of the conference was given over to the adoption of a model motor vehicle law to serve as a general pattern for states and municipalities. The proposed measures, which include registration and title certification acts, a chauffeur license act and a code for vehicle operation, follow in the main the recommendations of the committee of experts, though changed in some minor particulars. The conference also endorsed the report of the committee on enforcement, which recommended measures of organization and procedure to secure better enforcement of the laws and regulations affecting street and highway safety, and approved the report of the committee on causes of accidents which gives such information as is available as to causes of accidents and outlines a program for determining the cause of accidents with a view to their elimination.

The report most interesting to engineers was that of the committee on metropolitan traffic facilities which outlines a program for improvement of traffic facilities and recommends suitable plans of organization for its accomplishment. Little discussion was given to this report on the floor and to the report of the committee on statistics which presented essential facts of the accident record together with its recommendations as to improvement in the collection and analysis of accident statistics. The main features of the last two reports are given in the following abstracts:

Committee on Statistics

In the United States in the year 1924, 23,300 deaths and nearly 600,000 serious personal injuries occurred in street and highway accidents. Automobile traffic was involved in at least 85 per cent of these accidents.

There was an increase of 3 per cent in the number of traffic fatalities in 1924 as compared with 1923. This was due entirely to an increase in automobile accidents, which resulted in an increase of 6.8 per cent in fatalities. The number of fatalities caused by railway grade crossing accidents, by street car accidents, and by horse drawn vehicles, all declined in 1924.

Statistics available for the year 1925, dealing principally with the number of automobile accidents in large cities, indicate a further increase in the number of automobile fatalities, but the rate of increase was less than in 1924. For 78 cities in the aggregate, the fatalities increased 5.0 per cent from 1923 to 1924, and 2.4 per cent from 1924 to 1925.

The peak in the rate of increase, both in automobile fatalities and in other traffic fatalities as well, seems to have been reached in 1923. The rate of increase was less in 1924 than in 1923, and appears to have been less in 1925 than in 1924.

Railway grade crossing accidents, and the fatalities caused by them, increased about 3 per cent during the first ten months of 1925.

In 1924 the number of automobile fatalities declined in 6 of the states of the registration area, and remained stationary in 1 state. In 2 other states the number slightly increased, but the death rate from that cause slightly declined, while in 29 registration states the death rate increased as well as the number of fatalities.

There are encouraging indications of a reduction in the number of automobile accidents in some of the larger cities. Of the 78 cities of over 100,000 population for which comparable information is supplied by the Department of Commerce, 33 reported a decrease for 1924 in the number of automobile fatalities; in two cities the number remained stationary.

In 1925, as compared with 1924, 27 out of the 78 cities for which comparable information was available reported a decrease, while 3 cities showed no change.

Another hopeful sign was the progressive reduction in a few cities. Six of the principal cities showed reductions in automobile fatalities in both 1924 and 1925, while 2 of these cities reported reductions of 5 per cent or more in both years. The committee calls particular attention to the record of these cities, as an indication that what has been done in some localities can and should be done in others.

On the whole, and considering the record from every possible angle, the committee feels justified in the conclusion that the safety movement and safety education generally are beginning to produce results in the traffic field, where progress has been much slower than in the field of industrial safety. The battle is not yet won, however. Merely to record a reduction in the rate of increase in automobile fatalities is not sufficient. Fatal accidents in other forms of traffic accidents are declining. They should decline still further. The number and rate of fatalities in automobile accidents should also be reduced. There must be no lessening of intensive effort until this needless loss of human life has not only been checked, but has been reduced to the smallest possible proportions.

Committee on Metropolitan Traffic Facilities

The committee submits the following summary of its findings and recommendations:

With losses of life, personal injuries and actual destruction of property in traffic accidents estimated at $600,000,000 annually, additional losses resulting from congestion and extra distances traveled as a result of inadequate traffic facilities, increased maintenance and operating costs of vehicles due to improper road surfaces, excessive grades,

time lost at grade crossings and drawbridges, and other causes bring the annual loss to an estimated amount of $20 per capita on the entire population of the United States, or a total of more than $2,000,000,000 per annum.

These great annual losses constitute one of the most conspicuous and widespread economic wastes, reaching every individual, not only through the continual menace to life and safety but also through the increased costs of nearly every necessity of life. For the correction of this waste large expenditures are amply justified.

The magnitude of the sums involved in providing adequate traffic facilities requires due consideration of the serious burden of taxation involved, and a properly worked out and budgeted program.

Any program for improvement of traffic facilities will necessarily include some urgent, immediate items and some long-time items. The latter will generally call for thorough study and correlation with other improvements, but the necessity for thorough planning in such cases should not be permitted to prolong unduly the commencement of actual work, nor should it interfere with the prompt execution of urgent remedial measures.

Traffic Survey Necessary — As a basis for any comprehensive traffic improvement program, every community or metropolitan area should have a traffic survey giving the necessary physical data as to increase and distribution of population and vehicles, street, highway and transit facilities, industrial and commercial developments, schools, recreational facilities and other factors affecting the traffic problem. The survey should also give traffic data as to use of existing facilities, flow of traffic at various times, types of vehicles, average distances traveled, speed of operation, source, destination and other similar data. Once completed the survey should be kept up-to-date.

The program for improvement of traffic facilities may be part of a general city plan or metropolitan area plan, or, if no such plan has been established, a traffic program may be developed in advance of a more comprehensive plan. The traffic program should include: (*a*) A transit plan, covering facilities for the mass movement of population by vehicles of all classes, including rapid transit, steam railroad commuter service, street-car lines, bus lines, private automobiles and other means. (*b*) A street and highway plan, providing for main thoroughfares, bypass and interconnecting thoroughfares, secondary streets, business and industrial streets, and local residence streets, with any necessary enlargements and improvements required to carry the traffic with expedition and safety. (*c*) A traffic control plan, to provide for the orderly improvement of facilities and measures for the safe and efficient utilization of street and highway capacity.

Traffic Control Organization—To provide ways and means for developing and carrying out traffic improvements, a sound financial program should be established which will assure properly balanced progress in such improvements and which will properly distribute the burden of providing the necessary funds.

The magnitude and ramification of the traffic program are such that it will generally have to be carried out by a number of different departments of the city or local governments. A traffic planning organization is needed, however, to insure proper planning of traffic facilities and traffic control, to assure co-operation of the administrative agencies concerned and to enlist public support. This organization may consist of:

(*a*) An official traffic commission, including such officials as the chief of police, the city engineer, the engineer of the city plan commission, a representative of the public authority supervising city transit and transportation, a member of the city council, and a representative of the city's legal department. This commission should be a permanent body with the services of a paid staff, in charge of a technically trained engineer. It should prepare a comprehensive traffic plan, make and keep up-to-date the traffic survey and prepare a traffic ordinance and regulations or recommend from time to time modifications in the existing ordinance and regulations made necessary by changes in conditions.

(*b*) It will usually be of value to have an unofficial traffic committee, including the members of the official traffic commission together with representatives of automobile clubs and associations, safety councils, chambers of commerce, street railway companies, motor bus companies, retail merchants' associations, trucking organizations and other interested groups. The traffic committee should serve in an advisory capacity to the traffic commission and assist in securing the interest and support of various representative organizations and the public generally. If there is no traffic commission the traffic committee may temporarily carry out the functions of both bodies.

In the improvement of main highways leading to and from large centers of population it is frequently found that administrative jurisdiction over various sections of the road is divided among municipal, county, state and even national authorities. In such cases practical results in relieving traffic congestion will usually be obtained most quickly by voluntary co-operation between the authorities concerned through the creation of joint boards to consider and determine policies of location, construction, maintenance and use of the highways.

To provide unified consideration and treatment of traffic problems in metropolitan areas which include more than one city or a city and politically independent suburbs, it will generally be necessary to depend upon an enlargement of the unofficial traffic committee of the central city by adding proper representatives of important suburban communities, or in the case of two large cities in a single metropolitan area, to form a joint traffic committee with representatives of suburban communities added. When developments warrant, an official metropolitan authority may be created to control physical growth, supervise public utility services and provide for proper traffic facilities within large population centers.

In the development of the program, the conference adopted a report which says that it is necessary and appropriate that efforts should be centralized through the conference and its committees on future improvement of highway traffic difficulties. The problem remaining before the members of the conference, that of putting the program into effect, can best be forwarded by co-operative effort of the various associations and groups represented. It was, therefore, recommended that for each of the various subjects an execution committee be created to serve as a clearing house for securing co-operation among the groups concerned in promoting the adoption of the conference recommendations and that the Department of Commerce should keep in touch with the movement and at such future time as it seems necessary should call a third conference for further consideration of the problem.

Immigration and the Labor Supply

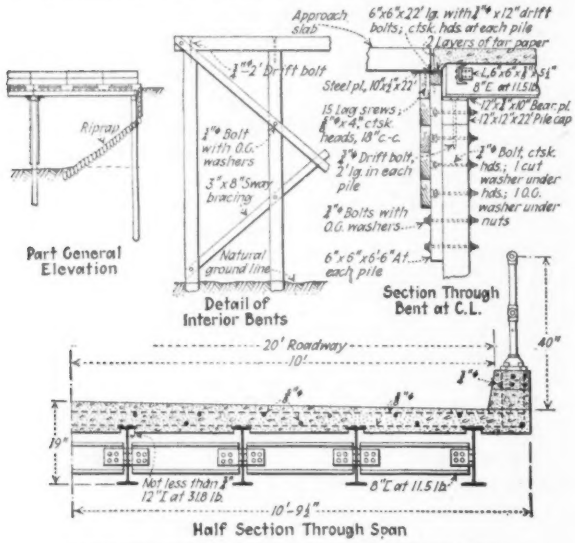
The trends in immigration noticeable during the first year under the new quota restriction law are continuing in the second year to show a number of interesting changes, according to an analysis made by the National Industrial Conference Board. There was again a net loss in common labor, but it was cut by more than half. Alien common laborers admitted from July 1, 1924, to Jan. 31, 1925, totaled 15,596, while 36,841 of this class emigrated during the period, leaving a net loss of 21,245. From July 1, 1925, to Jan. 31, 1926, 15,378 common laborers entered and 24,175 left the country, a net loss of 8,797. Alien skilled labor came and went in slightly larger numbers during the 1925-26 period than in the same period of the preceding year, and shows a slight gain in net immigration which arose from 22,775 in 1924-25 to 23,660 for the corresponding seven months' period in 1925-26. Obviously, according to the Conference Board analysis, we are gaining skilled labor and losing unskilled labor. The bulk of immigration under the new quota restriction law continues to come from Canada and Mexico.

Missouri Builds Timber Trestles With Concrete Floor

State Highway Department Establishes Standard Design Using Creosoted Wood for Main Members

SEVERAL creosoted timber pile trestles with reinforced-concrete floor will be built by the State Highway Department of Missouri during the present year. Creosoted trestles with creosoted timber floors have been built by the state rather extensively heretofore, but under heavy traffic the timber floor is short-lived. A creosoted pile structure has been found to have an economic life of at least 25 years, whereas an unprotected creosoted floor when subject to heavy traffic will last only four or five years and has, in fact, so short a life as to make it more economical to use untreated flooring. Surface protection of the timber floor by rock asphalt or other type of bituminous covering raises the cost to the point where a thin concrete slab can be built for the same money, at a great gain in service value.

The concrete slab floor construction on timber sub-


Approach slab
6"x6"x22' lg. with 1" x 12" drift bolts; ctsk. hds. at each pile
2 Layers of tar paper
1"-2' Drift bolt
Steel pl. 10"x1"x22'
L 6"x6"x1" x 51" 8"I. at 11.5 lb.
12"x1"x10" Bear. pl.
12"x12"x22' Pile cap
Riprap
1" Bolt with O.G. washers
3"x8" Sway bracing
15 Long screws; 1" x 4" ctsk. heads, 18" c-c.
1" Drift bolt, 2' lg. in each pile
1" Bolt, ctsk. hds.; 1 cut washer under hds.; 1 O.G. washer under nuts
1" Bolts with O.G. washers
Natural ground line
6"x6"x6'-6" At each pile
Part General Elevation
Detail of Interior Bents
Section Through Bent at C.L.
20' Roadway
10'
40"
19"
Not less than 1" 12"I at 31.8 lb.
8"I at 11.5 lb.
10'-9½"
Half Section Through Span

TIMBER TRESTLE WITH CONCRETE FLOOR
Over Locust Creek overflow in Linn County, Missouri. Built by Missouri State Highway Department.

structure has already been tried out and has been found to be satisfactory and economical. The adopted form of design comprises creosoted piles, creosoted caps, steel I-beam stringers, and a reinforced-concrete floor slab with pipe railing. In the drawing herewith the construction is shown as worked out for the bridge over Locust Creek overflow in Linn County, on the road from Hannibal to St. Joseph, about four miles west of Laclede. The stringers are 12-in. I-beams, 31.8 lb. per foot, spaced about 32 in., and held by separators of 8-in. channels. The floor slab usually is made 5 in. thick at the curb and 5½ in. at the center, but in the present structure an 8-in. slab is used; it has upper and lower reinforcing, the lower reinforcing consisting of ⅝-in. round transverse bars 7 in. on centers, and the top reinforcing of similar bars 14 in. on centers, while longitudinal ⅝-in. rods are spaced 18 in. in the top layer and 32 in. in the bottom layer. Expansion joints are placed over the pile bents at every third bent, or 60 ft., while simple partition joints are provided over the intermediate bents. A curb 10 in. high is cast separately, but is anchored to the floor slab by dowel rods; it carries a railing of 2-in. gas pipe.

One reason for the considerable extent of use of pile trestles on the state highway system is that the state contains many incomplete drainage projects, and it is probable that at some time in the future many structures now built will have to be replaced with permanent concrete structures or filled. Under such conditions the timber trestle type of structure is adopted pending the time when a permanent structure can be put in. On county roads carrying very light traffic a creosoted timber floor on such a structure may last for many years, but under the heavier traffic of main state highways timber floors wear out so fast as to be uneconomical. The concrete floor was therefore adopted.

A variation from this construction is projected for a bridge about 3,000 ft. long to cross the St. Francis River between Dunklin and Green Counties in Arkansas. Channel changes of this river make it proper to build for the present a temporary structure. It is expected to build this bridge of creosoted piles, creosoted bents, untreated cypress stringers, and concrete floor and curb with pipe railing. The tops of the cypress stringers will be treated with hot creosote oil during construction, and tar paper will be placed over them during the pouring of the slab to prevent entrance of moisture. When the floor slab is completed the stringers will be protected from the weather, and thus should have a long life, just as untreated timber in covered wooden bridges has proved to give a very long life in Missouri as well as in other parts of the country.

The St. Francis River bridge, like the Locust Creek overflow bridge shown by the drawing, is a federal-aid structure, and the construction shown has the approval of the U. S. Bureau of Public Roads. It was designed by the State Highway Department, under B. H. Piepmeier, chief engineer, and L. J. Sverdrup, assistant.

A Large Double-Deck Freight Station

A double-deck arrangement with tracks and driveways on both levels is an unusual feature in the new Bishopsgate freight station of the London & Northeastern Ry., at London, England; double-deck freighthouses on American railways have the tracks on one floor and the team driveways on the other floor, either above or below. At this London station, the railway is elevated and six approach tracks diverge to form a number of stub tracks, ten of which are in the freighthouse, while those on either side are team tracks with driveways reached by inclines on two sides of the station. On three tracks are hydraulic elevators large enough for handling the 10 to 20-ton freight cars, which are lowered to longitudinal tracks on the first floor or street level, which also has driveways. Turntables in these tracks enable the cars to be set out on lateral spurs in the several bays of the building, some of these bays being used by the railway for special classes of freight and others being leased to dealers. A third floor for warehouse purposes is divided into transverse bays, each with an overhead electric traveling crane. At one end of these bays is a monorail loop for electric trolley hoists; the monorail track passes above hatchways in the floor and is extended above and parallel with two of the second-story tracks, so that freight can be handled directly to and from cars. Hand and hydraulic jib cranes are installed on the three floors.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The West Coast and the A.A.E.

Sir—I have read with much interest the news item on p. 296 of your Feb. 18 issue concerning the withdrawal of the Oregon Chapter and the San Francisco Chapter from the American Association of Engineers. I wish to take particular exception to the inference in the article that the attitude of the San Francisco and Oregon Chapters reflects the sentiment of the entire West. As a matter of fact you may be interested to know that the attitude of the San Francisco Chapter reflects the sentiment of some of the members of that chapter, which is entirely contrary to the sentiment throughout the remainder of California.

San Francisco Chapter, with a territorial jurisdiction extending from Santa Barbara along the Coast to the Oregon line, was the largest A. A. E. chapter in California and at one time had a membership of nearly 500, being about 25 per cent of the membership of the A. A. E. in California. Verily it is the case of the tail wagging the dog. The extent of the chapter constituted its own weakness, and during the past few years chapters have been formed in some of the more outlying districts, which reduced the membership and extent of the San Francisco Chapter.

The plan of organization of the American Association of Engineers may be compared with that of the United States, consisting of a national government and local or chapter governments similar to the states of the Union. The United States government does not attempt to dictate the state taxation, and the action of the national board of directors in fixing national dues for the support of the national organization, and allowing the individual chapters to levy their own dues in accordance with their needs is a recognition of the rights of the local government to levy its own taxes. This policy will tend to strengthen the strong chapters and bolster up the weak chapters.

Those who are sincerely interested in the social and economic needs of the engineer will support the A. A. E. as the one existing national organization with those objects in view. The action of the San Francisco Chapter in withdrawing from the A. A. E. demonstrates a selfish interest in the San Francisco Chapter rather than a sincere interest in the principles for which the A. A. E. is working. Had San Francisco Chapter been less precipitate in its action, and given the new plan a fair trial with a determination to co-operate to the fullest extent with national headquarters, it is believed that its experience would have shown that the new policy was not detrimental to its interest.

Before taking action the National Board of Directors circulated the membership, with the result that their action was based on the opinion of a majority of the membership; incidentally, the poll in California showed a majority of the members in favor of the plan, which was subsequently adopted by the National Board of Directors.

Sacramento, Calif., March 11, 1926. L. V. CAMPBELL.

Sir—It seems desirable to correct the impression of western sentiment toward the American Association of Engineers that might follow the reading of your news item on page 296, Feb. 18, 1926, regarding the defection of two chapters.

When the Stockton Chapter learned that the adoption of methods by the National Board of Directors designed to revitalize the National Association and save it from threatened impotency was appearing to cause such resentment in certain quarters as might lead to secession, our chapter circularized Pacific Coast chapters in the interest of holding the organization intact.

The crucial test of the organizing and co-operative capacity of the engineering profession was at stake. The thought of national unity and of all the direct and indirect benefits accruing to engineers from a strong, vital, well supported, properly functioning national body won out everywhere over the narrower, more selfish consideration of local financial independence, with the exception noted in your item.

The impression given, however, is that western sentiment is reflected by these two chapters. On the contrary, in this section, the ideals and aims of the association as exemplified by both the national and local organizations, are gaining the support and adherence of engineers and the respectful attention of the public, as evidenced by greatly increased membership.

Any action that tends to disrupt or weaken the national organization is greatly to be deplored. A large body of western sentiment hopes for the return of these chapters to the national that we may all together "co-operate and advance." It is by working successfully through just such problems as this that we may prepare ourselves for administrative and executive positions beyond straight engineering.

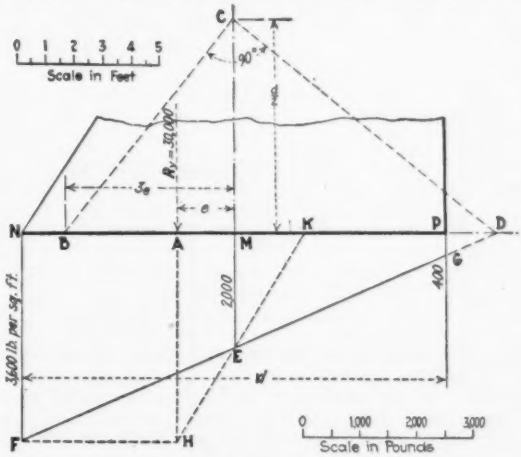
EXECUTIVE COMMITTEE, STOCKTON CHAPTER,
By W. B. Hogan, president; C. L. White, vice-president; Charles W. Gulick, secretary-treasurer; F. R. Bearman; Clarence V. Bovey; and J. B. Tyrrell.

Stockton, Calif., March 19, 1926.

Comments on Stress Distribution Diagram

Sir—The method given in your issue of Feb. 11, 1926, "Graphical Construction of Stress Distribution Diagram," by Joseph A. Wise, leads me to offer the following as perhaps a simpler method:

Using the same diagram and nomenclature, lay off *ME*,



STRESS DISTRIBUTION DIAGRAM SUBMITTED BY MR. HAY

the average intensity of pressure, and from the third-point, *K*, on the opposite side from *A*, draw a line through *E*, to intersect R_y, prolonged at *H;* from *H* draw the line *HF*, parallel to the base and perpendicular to *NF*. Draw the line *FEG* through *E* from *F*, and the stress diagram *PNFGP* is completed and may be scaled, as before.

The proof for this construction is similar. Triangles *KME* and *KAH* are similar, therefore

$$\frac{KM}{KA} = \frac{ME}{AH} \text{ or } AH = \frac{ME \times KA}{KM}$$

but $KM = \frac{1}{6}d$, $KA = \frac{1d}{6} + e$, and $ME = \frac{R_y}{b}$,

hence $AH = NF = R_y(b + 6e)/b^2$, which is the fundamental equation for the pressure between any two planes under normal forces.

It will be noted that the only calculation necessary is for the value of the average pressure *ME;* the third-point *K* is usually laid off when investigating for stability; there is only one intersection at other than a right angle.

The writer has no knowledge of the origin of this solution, but it was known to the late C. C. Schneider, and came

indirectly from him. It seems to be known in Europe, for it has been seen, without analysis, in "Agenda du Béton Armé," by V. Muzak. W. W. HAY.

New Brunswick, N. J.
Feb. 13, 1926.

Sir—In your issue of Feb. 11, 1926, p. 248, is shown a graphical construction of the stress distribution diagram under a dam or wall, where a linear law of distribution of the stress exists or is assumed.

The described construction seems to me to be considerably more complicated than the construction generally used.

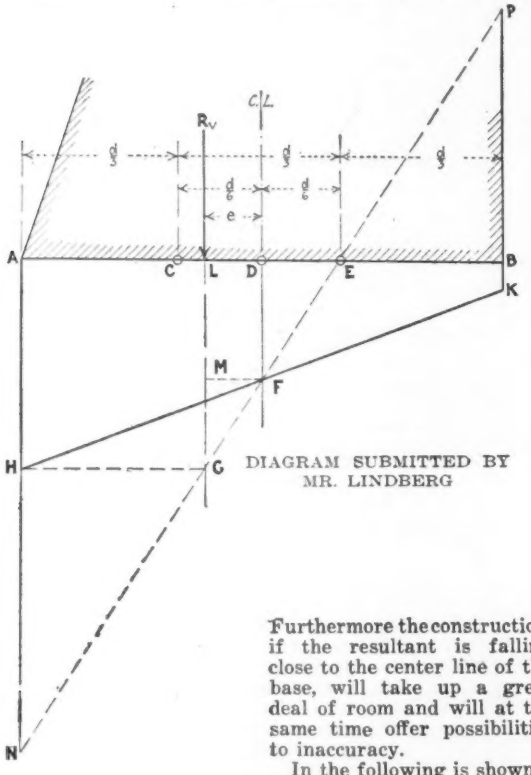


DIAGRAM SUBMITTED BY MR. LINDBERG

Furthermore the construction, if the resultant is falling close to the center line of the base, will take up a great deal of room and will at the same time offer possibilities to inaccuracy.

In the following is shown a construction that, I think, is more simple, easy to understand and that will not require any unnecessary room.

Consider the unit length of wall. Lay off, on center line of base, the average stress $DF = \frac{R_v}{d}$. Mark out one of the third points, in this case take E. Draw EF prolonging it to G, vertically below L.

Draw LG parallel and equal to AH'.

Draw HF prolonging it to K, vertically below B.

The stress diagram will be $ABKH$.

To prove this we will find that the line NP is the influence line for the stress at edge A.

Consider the point D as origin in a rectangular co-ordinate system with AB as x-axis and its positive part to the left, with the center line of base as y-axis and positive downwards.

The equation for the line NP in this co-ordinate system is of the form $y = mx + a$. In our case the variables y and x are p and e respectively. The intercept a equals DF or the average stress $\frac{Rv}{d}$:

The slope of graph m equals the tangent of the angle

$$FED = \frac{DF}{DE} = \frac{6.R_v}{d^2}.$$

The equation of the line NP is therefore, after substituting,

$$P = \frac{R_v}{d} + \frac{6\ R_v e}{d^2},$$

which is the influence line for the stress at the edge A, that is, the ordinate below the resultant is the stress at edge A.

To prove this geometrically considering the similar triangles DEF and MFG we have

$$\frac{MG}{MF} = \frac{DF}{DE}.$$

Solve MG and substitute $MF = e$; $DF = R_v/d$; $DE = d/6$; and we get $MG = 6R_ve/d^2$.

Further $AH = DF + MG = p = \frac{R_v}{d} + \frac{6.R_ve}{d^2}$.

THORE LINDBERG,
Bridge Department, State Highway Commission.

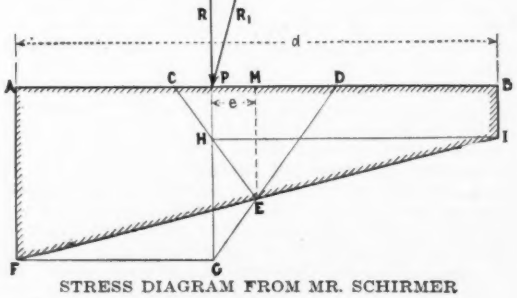
Raleigh, N. C.
Feb. 15, 1926.

Sir—The graphical solution of the distribution of stress in footings, retaining walls and other structures as given in *Engineering News-Record*, Feb. 11, 1926, p. 248, while extremely interesting can be simplified slightly. Another graphical method quite commonly used, which is indicated in a number of texts, is suggested below.

In the case considered let $AB = d$ equal the base of the structure over which the distribution of stress is to be made.

R = the vertical component of R', intersecting the base at P. Call the eccentricity $PM = e$.

b = the width of the base, and in this case is assumed as unity.



STRESS DIAGRAM FROM MR. SCHIRMER

The construction involved as is follows.

$$AC = CD = DB = d/3$$

From M the midpoint of AB lay off

$ME = P/A = P/d$ (Since b is equal to unity).

Draw CE and DE and extend the vertical through R to intersections as shown, namely G and H. Draw horizontals through G and H intersecting the verticals at the ends of the base at F and I.

The line FEI is the required closing line, and the figure $FABI$ is the pressure diagram to scale.

The proof of the construction as as follows.

$$PM = e$$
$$MD = d/6$$

The triangles MED and PGD are similar.

Therefore

$$PG : ME = (e + d/6) : d/6$$
$$PG = AF = \frac{P}{d}\left(1 + \frac{6e}{d}\right)$$

Formula 1 is a reduced form of the well known formula

$$S = \frac{P}{A} + \frac{Mc}{I}$$

$$PG = AF = \frac{P}{A} + \frac{Pec}{I} = \frac{P}{d}\left(1 + \frac{6e}{d}\right)$$

The proof for the distance $PH = BI = \frac{P}{d}\left(1 - \frac{6e}{d}\right)$ is similar to that given above.

When the point I falls above the point B tension exists across the base AB, which may be an impossible case, depending upon the assumptions involved.

H. A. SCHIRMER,
Structural Designer, Estuary Subway Officer, Alameda County Engineer.

Oakland, Calif.
Feb. 17, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

N. J. Sewage-Works Men Meet at Trenton

Sludge Digestion Chief Subject of Discussion—Short Course for Operators Proposed

(Engineering News-Record Staff Report)

A record-breaking attendance of more than 100 engineers in private practice and superintendents and others in charge of works and a lengthy discussion of sludge digestion which held some 50 of those in attendance for an evening session were features of the eleventh annual meeting of the New Jersey Sewage-Works Association at Trenton on March 25. Engineers and chemists from New York, Massachusetts, Pennsylvania and Ohio swelled the attendance and contributed to the proceedings.

The association endorsed a proposal for a short course for sewage-works operators at Rutgers College, in cooperation with the State Board of Health, as recommended by a special committee on improvement of the status of sewage-works operators. The course would extend to some two or three weeks and would include lectures, laboratory work and inspection trips. There would be a nominal fee for those in attendance from within the state with a slight additional charge for any who came from outside. The association voted to promote legislation for the payment by municipalities concerned of the expenses of operators who attended the school from within the state and also like payment of the expenses of employees attending conferences at the recommendation of the State Department of Health or its director, the second proposal having been recommended for adoption by Dr. H. B. Costill, director, New Jersey Department of Health.

New Officers Elected

New officers elected were: President, P. N. Daniels, senior sanitary engineer, State Board of Health, Trenton; vice-presidents, Asher Atkinson, city engineer, New Brunswick, and Chester J. Wigley, consulting engineer, Atlantic City Sewerage Co. John R. Downes, manager of the Plainfield Joint disposal works, was re-elected as secretary. The probable continuance for a second year of a $1,000 grant by the Chemical Foundation for research work at the New Jersey Sewage Experimental Station was reported by S. Fisher Miller, president, Pacific Flush Tank Co.

The discussion on sludge digestion was opened by a paper on Practical Applications of the Findings of the New Jersey Sewage Experimental Station, y Weston Gavitt and Richard W. Gould, members of the association's research committee. For the remainder of the three or four hours devoted to the discussion on sludge digestion Dr. Willem Rudolfs, director, New Jersey Sewage Experiment Station, New Brunswick, was the storm center from which emanated a large amount of information as to sludge digestion experiments on a laboratory scale, to which were directed hundreds of questions from the audience, many of the latter also contributing materially to the data and opinion presented. The main point brought out was that these tests promise to point the way to a means of control of sludge digestion, largely through regulation of the pH index. Mr. Batey, Rockerfeller Foundation research scholar at the Harvard School of Engineering, reported that laboratory tests which he was making confirmed the conclusions announced by Dr. Rudolfs wherever the experiments at the two places coincide in subject and method.

Round Table Discussion

Before getting into this technical discussion, plenty of material was presented for the benefit of every-day sewage-works operators. A "round-table discussion" on surchanging sanitary sewers by heavy rains and melting snow and the resulting effect upon sewage treatment and on cleaning sewage deposits from sewers emphasized anew the importance of more rigid means of control than are usually exercised to exclude roof and cellar waters from sanitary sewers. The committee on equipment for sewage-works reported, through Weston Gavitt, lists of tools and equipment for various purposes in connection with the maintenance of sewers and of sewage-works.

Sludge drying on open beds and under glass were compared in a paper by Frank W. Jones, who is associated with George B. Gascoigne, consulting engineer, Cleveland, Ohio. The general conclusions of the paper were decidedly favorable to drying sludge under glass —as is now practised at Alliance, Canton and Marion, Ohio, Chicago, Ill., and Boonton, N. J. In a paper on Sewage Disinfection, P. N. Daniels, Trenton, stated that of 300 sewage-works in New Jersey, disinfection is now practised at 46, with 13 still using hypochlorite and 38 liquid chlorine.

Engineering Fifty Years Ago

From *Engineering News*, April, 1876

LIEUT. RUFFENER, Chief Engineer of the Department of the Missouri, departed from Ft. Leavenworth last Tuesday morning with an expedition numbering one hundred men, for the Pan-handle and Red River country in Texas, for the purpose of surveying that region. They will equip at Ft. Dodge on their way.

Work on New Cascade Tunnel Well Under Way

Work in Progress at Four Points—Pioneer Tunnel to be Used at West End

Rapid progress on the preliminary work for the 7¾-mile Cascade tunnel of the Great Northern Ry. has been assisted by an unusually mild winter. As already explained in *Engineering News-Record* of Jan. 7, 1926, p. 28, different methods of driving will be employed. From the west end, a pioneer tunnel 9 ft. wide and 8 ft. high will be driven parallel with and 66 ft. from the main tunnel, with cross cuts to the latter at ¼-mile intervals. From these cross cuts a center heading 10 x 10 ft. will be driven on the line of the main tunnel, behind which will come the enlargement to full size rock section 18 x 24 ft. At the east end there will be no pioneer tunnel, but the center heading of the main tunnel will be driven from the portal, while a shaft will be sunk about 2¾ miles from the portal, so that the main heading may be started east and west from that point.

The new tunnel will be 7.75 miles long on a 1.53 per cent grade. The new line, of which it is a part, will lower the summit elevation 506 ft. and result in a saving of 7.67 miles in distance. A total of 6.04 miles of snow-sheds will be eliminated as well as considerable curvature.

Working from Several Points

Progress may be summarized as follows: On Nov. 25, 1925, the contract was awarded to A. Guthrie & Co., St. Paul, and by Dec. 4 camp sites were being cleared near Berne and Scenic, at the east and west ends respectively. The west approach cut for the pioneer tunnel was started Dec. 14, and that for the adit to reach the center heading at the east portal on Dec. 29. On Jan. 1, a road was completed to the camp site for the Mill Creek shaft and shaft sinking was commenced Jan. 30. As the west end of the tunnel will pass under the north fork of Tye River, it was decided to sink an inclined shaft on the east bank to reach the line of the pioneer tunnel; this will avoid the delay of probably difficult work from the portal to the river crossing.

At the end of February, there was a force of 350 men at the west portal, 102 at the east portal and 170 at the shaft. The progress during this three-month period was 448 ft. in the west pioneer tunnel, 118 ft. on the river incline, 464 ft. at the east portal adit and center heading and 61 ft. in the Mill Creek shaft. R. F. Hoffmark is general superintendent for the contractors, with W. E. Conroy as assistant general superintendent. The work is being done under the direction of J. R. W. Davis, chief engineer of the Great Northern Ry., Colonel F. Mears, assistant chief engineer, is in direct charge.

Los Angeles Building Pedestrian Tunnels for School Children

Ground was broken March 15 on the first of a series of subways or pedestrian tunnels at street intersections in Los Angeles to be built under a $350,000 bond issue passed last June. These tunnels will be near public schools and are intended particularly for reducing street accidents to school children.

About 50 such tunnels are now planned and it is believed that this number can be built with the funds available, estimates of the cost being about $7,000 each. Due to the large number that will be built (funds for more tunnels may be voted if the plan proves as popular as is now expected) details of the design have been studied and worked out by the city's bridge department much more elaborately than would have been justified by any single structure.

Electrically Welded Pipe for Medford, Ore., Water Supply

A contract for 159,000 ft. of electrically arc-welded pipe has been awarded by the city of Medford, Ore. to the Beall Pipe and Tank Corp. of Portland. This is one of the largest orders for electrically welded pipe in the west since the contract for 85 miles of this kind of pipe for the East Bay water supply project at Oakland, Cal. (See *Engineering News-Record*, Oct. 8, 1925, p. 608 and Nov. 12, 1925, p. 785.)

The pipe ranging from 20 to 25 in. diam. and 8 gage to ¼ in. thickness is to be used for the municipal water system. It is to be welded by the automatic electric welding process at the plant and will then be dipped in specially prepared mineral rubber and wrapped with pipe wrapping paper. The pipe sections will be welded together when they are put in the trench.

U. S. Engineers Report Adversely on Trinity River Project

Flood control of the Trinity River, Texas, by dams and reservoirs above and below Dallas have been reported upon adversely by the U. S. Engineers of the War Department as not a project for the Government to undertake. The conclusions are as follows:

(a) The Federal interest at this time is not such that the United States Government should adopt a project for flood control or bear any part of the cost of any project which may be adopted by local interests.

(b) Navigation would not be materially benefited by works for flood control.

(c) The cost of reclamation of the entire valleys of the main river and tributaries would approximate the resulting increase in value of the reclaimed land.

(d) The control of floods on the Trinity River, Texas, by means of reservoirs alone is not considered practicable due to the large cost of reservoirs, their small capacity, and the fact that they could not be emptied quickly without causing overflow of the river banks.

(e) The conditions are not suited to a combination reservoir system for flood control and water uses, such as power and irrigation.

(f) It is considered that the present method of reclamation should be continued, namely: The organization of improvement districts operated under existing state laws by the owners of land to be reclaimed.

Rush-Hour Closing of Jersey Bridges Sought

U. S. Asked to Close Structures Over Newark Bay, Hackensack and Passaic for 4 Hours

Individuals representing govermental, municipal, civic and corporate interests of the states of New Jersey and New York have submitted to the War Department a request that the drawbridges over Newark Bay and the Hackensack River be closed between the hours of 7 and 9 a. m. and 4:30 and 6:30 p. m. This new request for the relief of commuter travel is based upon an intimate study of the conditions now existing. The bridges involved are two railroad structures across Newark Bay; three railroads and one highway bridge from Newark to Kearny, three railroad and two highway bridges from Newark to Harrison, and one highway between Newark and East Newark, these ten crossing the Passaic River; and three railroad and two highway bridges between Kearny and Jersey City, two railroad bridges between Kearny and Secaucus, one between Lyndhurst and Secaucus and one between Rutherford and Secaucus, across the Hackensack River. In all 21 bridges are affected.

Costly Delays to Traffic

From a study of delays during the month of July, 1925, it is discovered that 221,278 hours were lost by New Jersey railroad commuters because of drawbridge openings. This study also revealed that between 7 and 9 a. m. and 4:30 and 6:30 p. m., the intervals during which it is proposed that the bridges should remain closed, the time loss by New Jersey railroad commuters was 47 per cent of the total.

From investigation of traffic over one system of highway bridges affected an estimate is made that approximately 7,800,000 tons with a value of $800,000,000 is the present annual value of motor truck freight over the bridges. This is opposed to the 1924 record for the waterways which the bridges span of approximately 6,600,000 tons valued at about $250,000,000. These are government figures. The report points out that on this basis alone it would be economically sound to advocate that water traffic be limited to the night hours so as not to interfere with the volume of land traffic which occurs principally during the period between 7 a. m. and 7 p. m. However, this would be considered too drastic a change, and the situation would be materially relieved by giving motor vehicles right-of-way during the hours it is proposed to close the bridges.

A record of 20 months in 1923 and 1924 shows that on a 24-hour basis between 7 and 9 a. m. and 4:30 and 6:30 p. m., 21 per cent of the total openings of bridges occur. On a 12-hour day basis, 24 per cent of the number of openings occurs during that 4-hour period. Inasmuch as over 90 per cent of the openings were between 7 a. m. and 7 p. m., it is considered fair to make the comparison on the 12-hour day basis rather than on the 24-hour basis. On the 12-hour basis three times the number of openings occurred during the 8-hour period in comparison with the openings for the 4-hour period suggested for closing. In other words, there was 36 per cent less traffic per hour during the hours suggested for closing than during the period suggested for opening.

The plea to the War Department also contained reference to the Boston situation, wherein relief from congestion was secured by closing bridges over the Mystic and Charles Rivers and Ft. Point channel during rush hours. The plea cites the fact that the New York situation is a great deal more acute than the Boston one was in 1910 when relief was granted.

Accompanying the plea to the War Department are numerous exhibits, including graphs showing the continued increase in delays to New Jersey commuters; tabulation of trains over bridges at 15-minute intervals; number of passengers by bridges; delays per passenger, etc., by bridges; number and type of vehicles per day by highway bridges; number of vehicles by hours over highway bridges; average maximum and minimum number of vessels per day by commuter railroad bridges; analysis of vessel operation by tide, classes of vessels, etc.

The petition bearing 175 signatures was prepared under the direction of the following commission: W. H. Truesdale, Chairman of the Board of the Lackawanna; A. E. Owen, Chief Engineer of the Central of New Jersey; G. J. Ray, Chief Engineer of the Lackawanna; J. J. Mantell, Vice President of the Erie; J. V. Davies, Vice President and Chief Engineer of the Hudson & Manhattan; F. D. Davis, Superintendent of the Pennsylvania; Walter Kidde, New Jersey State Highway Commission; F. J. Radigan, County Engineer for Hudson County, and A. W. Coffin, Executive Secretary of the North Jersey Transit Commission.

No date for the hearing has been set by Col. Deakyne, district engineer at New York.

Aerial Transportation Symposium Held at Philadelphia

A symposium on aerial transportation was held on March 16 by the Engineers' Club of Philadelphia. Afternoon and evening sessions were held, the latter being a dinner meeting. Major General Sir Sefton Brancker, director of civil aviation in the British Air Ministry spoke at the evening meeting and told of the developments of aviation in Great Britain, including plans for a regular route of airships from Canada to Australia. Other speakers at the evening session included C. C. Grove, assistant postmaster general of the United States, J. Walter Drake, and William P. McCracken. Speakers at the afternoon meeting were C. M. Keys, president of the Curtiss Aeroplane and Motor Co., Col. Paul Henderson, general manager of the National Air Transport, Inc., W. M. Stout of the Ford Motor Co., and Capt. George W. Steele, U. S. N. of the Lakehurst Station.

Pennsylvania R.R. to Electrify Philadelphia Lines

Announcement has been made by the Pennsylvania Railroad that the lines between Philadelphia and Wilmington and between Philadelphia and West Chester will be electrified, the work to be completed by 1927. It is estimated that the total cost of electrification on these lines will be $10,000,000, exclusive of the new electrically equipped cars that will be required. Electrification of these two lines is an integral feature of the railroad improvements in connection with the new station to be built on the west bank of the Schuylkill River and the subway station as 15th Street for suburban traffic. The project involves four tracks between Philadelphia and Wilmington, and sections of double and single track between Philadelphia and West Chester. The total number of miles of line to be electrified is about 52 and the miles of track will be about 150. The present electrified suburban lines out of Philadelphia, comprising the Paoli, Chestnut Hill and Fort Washington lines, include 38 miles of road and 114 miles of track.

Pennsylvania Constructors Have Annual Banquet

The sixth annual convention of the Associated Pennsylvania Constructors closed March 23, with a dinner at which there were 300 diners representing contractors and builders from the entire state. Henry E. Baton of Philadelphia acted as toastmaster and responses were made by James H. Ellison of Minneapolis, president of the Associated General Contractors of America; Gen. R. C. Marshall, Jr., of Washington; Dr. John L. Davis, of New York and Wm. H. Connell. At the close of the dinner a gold watch was presented to Lea Hunt, of Wilkes-Barre, retiring president of the organization.

Speakers and their subjects at a meeting preceding the dinner, presided over by Clarence E. Lott, of Pittsburgh, were as follows: James H. Ellison, of Minneapolis, president of the Associated General Contractors of America, The Government in Business — What it means to you; General R. C. Marshall, of Washington, Accident Prevention and Contract Bonding Situation; S. M. Williams, of Philadelphia, vice-president of Autocar Company, Standard Questionnaires for Bidders, and Charles A. Waters, attorney of Philadelphia, Pennsylvania Lien Laws as Applied to the Construction Industry.

At the morning session officers for the ensuing year were elected. They were as follows: Edward McGrady, of Pittsburgh, president; Henry E. Baton, of Philadelphia, first vice-president, and David A. Challis, of Sewickley, treasurer, Clarence E. Lott, of Pittsburgh, and Samuel M. Irwin, of Philadelphia, were elected members of the board of governors to serve for two years. Four regional vice-presidents were also elected. They are: R. D. Richardson, of Scranton, Joseph B. Comerford, of Philadelphia; Walter A. Godcharles, of Milton and Foster H. Berkebile, of Johnstown.

Export of Power from Province of Quebec Prohibited

The exportation of electric energy from the province of Quebec to the United States is prohibited by an act of Parliament passed at a sitting of the provincial legislature on March 22. The principal clause of the bill reads: "Every sale, lease or grant whatsoever of water powers belonging to the province, or in which it has rights of ownership or other rights, made on or after the coming into force of this Act, shall contain a clause prohibiting the exportation, outside of Canada, of the electric power which may be developed in this province."

Any violations of the provisions of the act will result in rendering null and void any sale, grant or contract made by the Crown.

North Dakota Supreme Court Again Upholds Bismarck Zoning

The validity of the zoning ordinance of Bismarck, N. D., has again been sustained by the State Supreme Court, in affirmation of a lower court decision. (City of Bismarck vs. L. W. Hughes). The defendant is enjoined from building an apartment house contrary to the zoning ordinance, the specific complaint being that the purposed building was not located in relation to the property line as the zoning ordinance requires and that it would cut off light and air from adjoining buildings. The City of Fargo filed briefs in the case as a friend of the court. Editorial comment and extracts from the opinion in the earlier decision of the North Dakota Supreme Court appeared in our issues of July 2, 1925, pp. 2 and 29.

War Department to Pass on Adequacy of Cairo Bridge Plans

In passing on the bill granting the consent of Congress for the construction and operation of bridges over the Mississippi River and over the Ohio River at Cairo, Ill., the House Committee on Interstate and Foreign Commerce requires the Secretary of War and the Chief of Engineers to determine whether or not the proposed structures are adequate for the vehicular traffic that they will be called upon to accommodate. Heretofore the Chief of Engineers in passing on bridge plans has examined them only from the standpoint of navigation.

The proposed bridges are to connect Cairo with State Highway No. 16 in Missouri and Cairo with the Wickliff-Paducah road in Kentucky. The bill proposes to vest the rights in Harry E. Bovay, who will build, maintain and operate the bridges on a toll basis. The rates charged for the use of the structure must be reasonable. If unreasonable charges are assessed new rates may be prescribed by the Secretary. At any time after twenty years the states or any political sub-division thereof may take over the bridges at a fair valuation, provided they are to be operated without the collection of tolls.

The committee was advised that the Missouri law prohibits the use of public funds in the construction of toll bridges and that as each structure probably will cost $8,000,000 the highway departments in Kentucky and Illinois will not be in position for many years to attempt the construction of such expensive structures.

A bill has been introduced granting rights to Mr. Bovay for a bridge over the Mississippi at Vicksburg.

Three Types of Movable Bridges in a Group

Construction of the new bascule bridge of the Florida East Coast Railway Co. over the St. Johns River at Jacksonville, Fla., has brought about a unique situation in which three distinct types of movable bridges are grouped at one point. The single-track swing span, over which the train is passing, was built in 1887 from designs by George S. Morison and served to carry Florida East Coast Ry. traffic up until Nov. 24, 1925, when it was replaced by the 216-ft. double-track, bascule bridge shown at the right of the picture. Beyond the railroad bridges is the vertical lift span of the Duval County highway bridge which was built about four years ago. The new bascule bridge is said to be the heaviest of its type ever constructed.

Two Practical Papers Read Before New York Section A.W.W.A.

The New York Section of the American Water Works Association held its last luncheon-meeting of the season in New York City on March 25. After the election of William A. McCaffrey, superintendent of water-works, Oswego, N. Y., as a member of the board of governors for 1926-27, two practical papers showing how water-works emergencies were met were read.

F. E. Beck, chief engineer, Consolidated Water Co., Ithaca, N. Y., told of the breakdown of a steel truss bridge carrying a 24-in. water main across a gorge 80 to 90 ft. deep and the replacement of the truss by a suspension bridge and of the cast-iron pipe by wood stave pipe. The failure of the bridge is believed to have been due to an ice load caused by a leak in the main. The pipe line was one of two serving the city from different sources. Pending reconstruction of the bridge, a 10-in. wrought-iron pipe was drawn across the gorge and connected into the 24-in. pipe line by means of wooden plugs with leadite for calking. The suspension bridge was built and the wood stave pipe placed within a week after the assembling of material on the ground.

How Newark, N. J., increased the delivery capacity of its steel conduits leading from the Pequannock supply was described by John A. Foulks, consulting engineer, Newark, N. J., formerly chief engineer of Newark Water Department. One of the conduits was connected to the distributing system in Newark at a lower level than formerly. The other conduit was extended upstream by means of wood stave pipe so as to increase the head by 80 ft. These two measures combined raised the discharge capacity of the two pipe lines from 54 to 62 m.g.d. The cost was about $125,000.

Contract for Portsmouth Bridge Let on Suspension Design

Award of a contract for the construction of a highway bridge over the Ohio River between Portsmouth, Ohio, and Fullerton, Ky., to the Dravo Contracting Co. of Pittsburgh has just been announced. The bridge is to be built for the Portsmouth-Fullerton Bridge Co. J. E. Greiner, Baltimore, is consulting engineer to the bridge company. Three bids were recived on a cantilever design and one bid on a suspension design, the latter being prepared by Robinson & Steinman, consulting engineers, New York, for the bidder.

The span of the bridge is 700 ft. and approaches of some length are required. The suspension design was worked out with 350-ft. side spans, and due to local conditions the anchorages had to be placed three spans beyond the end of the side span on either bank. This condition and the short length of main span did not present specially favorable conditions for the suspension type, and the fact that the suspension bid was lowest is therefore specially interesting. The successful design uses two parallel wire cables of 7-in. diameter, and a stiffening truss continuous over three spans. The roadway width is to be 22 ft. between curbs, plus one 6-ft. sidewalk, with provision for adding a second sidewalk later.

The design loading is three 15-ton trucks or two 20-ton trucks abreast.

Construction is to begin at once. The Dravo contract covers both substructure and superstructure. The cost of the entire undertaking, including right-of-way cost, probably will approach $1,000,000.

Suggests Congress Delay Action on Lakes to Hudson Canal

Major General Harry Taylor, Chief of Engineers, U. S. Army, in a report to Congress on a waterway from the Great Lakes to the Hudson River, suggests that before Congress makes a decision it should have before it the report of the Joint Board of Engineers on the St. Lawrence River, a report which will be due in a short time. General Taylor draws attention to the adverse report of the board of engineers appointed to study and report upon the proposed canal across New York State and says: "From the economic angle it would seem that Congress should possess full information in both routes before making a decision on a case involving such large expenditures and such far-reaching possibilities."

In closing his report General Taylor recommends that the War Department be authorized to make a further study of the proposition to build a canal across New York State, with neither a definite date on which the report must be submitted nor a definite depth for the canal specified.

Seattle Votes $2,125,000 Bonds for Sewage Disposal

At the election on March 7 a bond issue of $2,125,000 for the diversion of sewage from Lake Washington was voted. Intercepting sewers, pumping stations and an outlet sewer to Puget Sound will displace three existing and 13 projected small district treatment plants discharging into Lake Washington, consisting of grit chambers, Imhoff tanks and chlorinating apparatus. J. D. Blackwell is city engineer.

New York Building Law Eliminates Surety Bonds

Under the provisions of a bill introduced in the Assembly by John J. Cooney, Democrat of Brooklyn, section 14 of the Public Buildings Law of New York State is amended by providing that contractors need not give a bond but must show to satisfaction of state architect assets in excess of liabilities to equivalent of 15 per cent of amount and also that they have successfully executed work of same character and scope; contractors must pay to State a certain fixed sum as liquidated damages. The report of State Architect Sullivan W. Jones advocating such legislation was summarized in *Engineering News-Record*, March 18, 1926, p. 444.

RANDOM LINES

Nil Nisi, etc.

A citizens committee in New York State is trying to get an appropriation of $500,000 out of the Legislature to celebrate the centennial of the Erie Canal. After Frederic Stuart Greene's report last week and Governor Smith's general remarks on the canal, isn't this carrying pretty far the idea that one should speak only good of the dead?

* * *

A Record Snow Fall!

"Upstate, particularly in the extreme northern and western sections, as much as six feet of snow fell, driven by a furious wind. So strong was the gale that some roads were lost under drifts that mounted as high as 100 ft., according to the Associated Press."

This from the conservative *New York Evening Post* which prides itself on the accuracy of its statements.

* * *

What Causes Earthquakes?

At the risk of violating the copyright which the manuscript claims, we offer the following first paragraph of an article just submitted to us. It is so completely explanatory that it seems a waste of space to print the rest of the article:

"There is but one cause and one cause only for earthquakes, volcanoes, seismic disturbances of all kinds, and sun spots and eruptions on the moon. These disturbances are causes by the Malefic influence of the Cyclic Correlative Cause and Effect of Natural Law that applies to these things. There is no use to try to apply any other manufactured cause for they will not operate and bring results."

* * *

Northern Propaganda Again

"The east coast of Florida, at least from the middle of the state to Miami and beyond, is in for an early and a pronounced deflation . . . I have not the courage to try to predict when the boom will break, but break it will, of course, and my guess is that it will come at the end of the current winter season." Frank C. Wight in *Engineering News-Record*, Jan. 14, 1926.

Special dispatch to the New York *Times*, Palm Beach, March 10:

"With the real estate business here almost at a standstill, hundreds of Florida realtors are migrating north. Scores of small offices have been closed overnight, until a few weeks ago office or desk space in the business sections of Miami and West Palm Beach was scarcely to be had at any price. Although the big real estate developments still report some activity in sales, the small concerns are doing no business at all. Palm Beach is rapidly becoming deserted, most of the hotels are virtually empty, and northbound trains are carrying capacity crowds."

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 10-13, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Philadelphia, Pa., June 13-19, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

INTERNATIONAL CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Building Officials' Conference will hold its annual meeting at Columbus, Ohio, April 27 to 30. The papers to be given will be announced later. Inspection trips will be made to the Ceramic Laboratories of the U. S. Bureau of Mines and to certain tile-making plants.

The Indiana Section, American Water Works Association, held its annual meeting at Purdue University March 25 and 26. The program included: Development of the Boonville Water Supply, Charles Brossmann; Methods of Measuring Fluids, Prof. F. W. Greve; Public Health Achivements, Dr. A. J. McLaughlin, U. S. Public Health Service; Water shortage in Indiana, L. S. Finch, Indiana State Board of Health; Electrification of Lafayette Water Supply, John W. Moore; Proportioning Concrete by Water-Cement Ratio, Prof. W. K. Hatt; Pollutional Organisms, W. C. Purdy, U. S. Public Health Service; Pipelaying Methods, John W. Toyne. The secretary is C. K. Calvert, Indianapolis, Ind.

Personal Notes

FRANK C. TOLLES, until recently in general engineering practice at Akron, Ohio, has joined the organization of George B. Gascoigne, consulting engineer, Cleveland. Mr. Tolles was formerly superintendent of public works for the city of Akron and was especially concerned with the question of garbage disposal; he has also been associated with the sewerage projects of Louisville, Ky., Cincinnati, Ohio, and as district engineer for the International Joint Commission at Buffalo, N. Y.

JOHN B. WRIGHT, formerly city engineer of Keene, N. H., has been chosen city manager of Keansburg, N. J., succeeding Ralph K. Linville.

A. S. HADLEY, engineer and general superintendent of the Gulf Bitulithic Co., Houston, Texas, for the past several years, sails for Tokio, Japan, April 4 to become resident engineer for Warren Brothers Co. of Boston.

WALKER R. YOUNG, who has been in charge of the investigation of the Tidewater dam project in the Sacramento, Calif., district for the United States Bureau of Reclamation, has been appointed construction engineer for the Kittitas high-line canal to water 75,000 acres of Kittitas valley land.

E. C. EARLE, for several years vice-chairman and chief engineer for the Manila harbor board, port of Manila, P. I., has been appointed assistant harbor engineer for the port of Los Angeles, Calif.

HARRY C. JESSEN, acting city engineer at Salt Lake City, Utah, since last August, has been appointed city engineer. Mr. Jessen entered the city's engineering department in 1911 as a computer and was made assistant city engineer in 1918.

FRANK P. CARTWRIGHT, for the past four years technical secretary of the Department of Commerce Building Code Committee, has become engineer and technical representative of the National Lumber Manufacturers Association. Mr. Cartwright is a graduate in civil engineering of Cornell University in the class of 1915. Before going to the Department of Commerce Building Code Committee, he was, for a time, with the New York State Highway Commission and subsequently on railroad construction.

FOREST KAUFMAN has been apointed manager of the southwestern offices of the Portland Cement Association, with headquarters in the Gloyd Building, Kansas City, Mo.; this position has jurisdiction over assoication work in Nebraska, Oklahoma, Texas, Wyoming, Colorado, New Mexico, and western Missouri. Mr. Kaufman has been with the association since 1916, serving first as field engineer in Illinois and later as district engineer in charge of the Kansas City office, still later district manager in charge of Kansas City and Oklahoma City offices.

J. C. MCLEOD, division engineer of Division 10, California Highway Commission, with headquarters at Sacramento, Calif., has resigned to take a position with Force & Currigan, contractors of Oakland, Calif. Mr. McLeod is succeeded by R. A. PIERCE as acting division engineer. Mr. Pierce was previously maintenance engineer in Division 10.

WARREN & VAN PRAAG (INC.) is the new firm name of the former consulting firm of Holbrook, Warren & Van Praag, Decatur, Ill. Mr. Holbrook, the retiring member, dropped out of active participation three years ago when he became connected with the Sanitary District of Decatur. W. D. P. Warren is president of the new company as he was of the old one.

Obituary

COL. CHARLES SWIFT RICHÉ, Corps of Eningeers, retired, died suddenly in Houston, Texas, March 20, aged 61 years. Colonel Riché was a native of Philadelphia. His early engineering work was in Great Lakes and Mississippi River improvements, at Detroit, Chicago, and on the Hennepin Canal, and in charge of the Mississipi River work from the north to St. Louis. In 1912 he took charge of the Galveston engineering district, where extensive work was carried on in shore protection. In 1924 and 1925 he was a member of the Engineering Board of Review of the Chicago Sanitary District.

JOSEPH STRACHAN, Brooklyn, New York, for twenty-five years secretary of the Brooklyn Engineers' Club, died March 22, aged 67 years. He was born in Newburgh, N. Y., and graduated in civil engineering from New York University. In 1889 he became a draftsman in the department of water in the old city of Brooklyn, and in 1890 assistant engineer in that department. In 1902 Brooklyn being then part of New York City, he became division engineer in the Brooklyn borough department of highways.

MAJ.-GEN. OSWALD H. ERNST, Corps of Engineers, retired, and Civil War veteran, died March 21 in Washington, D. C., aged 83 years. General Ernst was born in Ohio, studied two years at Harvard, then was appointed to West Point from Ohio. He was graduated in 1864 and served as chief of engineers in the Army of the Tennessee. After the Civil War he served as assistant engineer on Pacific Coast fortifications, as engineer in charge of western river and harbor improvements, from 1889 to 1893 in charge of public buildings and parks in Washington, D. C., and several years as superintendent of the military academy at West Point. Between 1900 and 1905 he was in charge of river and harbor work at Baltimore, at Chicago, division engineer of the Northwest Division, engineer officer of the Lakes Division, and chairman of a board of engineer officers to survey a waterway from Chicago to St. Louis. Later he was a member of the Isthmian Canal Commission, president of the Mississippi River Commission from 1903 to 1906 and chairman of the American Section of the International Waterways Commission.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Telephone Boxes Used as Signposts

In Great Britain, the Automobile Association has installed a number of roadside telephone boxes which, in addition to affording the usual roadside telephone facilities for motorists, provide an innovation in illuminated signposts.

Erected at important cross-roads, they are larger and higher than the ordinary A.A. telephone boxes, and are constructed of wrought sheet steel, with the exception of the doors, which are of wood. A steel post, approximately 20 ft. high, passing through the center of the box, carries the necessary number of arms, giving signpost information. In addition to the names of towns or villages and the mileages, the road classification is also shown.

The arms of the signpost are illuminated after dark by lamps using either low-pressure carbide or, if available, electric current. The lamps are situated on the roof, which is painted white in order to reflect the light upwards toward the signpost arms. A separate lamp is provided for lighting the interior of the box, to enable motorists using the telephone to consult the telephone directory, etc. The telephones, as is usual with all the A.A. roadside telephones in Great Britain, are available at any time during the day or night.

Marketing Problems in the Pump and Engine Field

The following statements taken partly from the tenth annual report of the Worthington Pump & Machinery Corp., New York City, give a picture of the market situation in this company's field and also show somewhat the necessary trend in the design of its equipment.

According to the report, the great problem of the company for several years has been the adaptation of its products to a changing market. "This results from the rapid trend, particularly since the war, from vertical water-works, crank and flywheel, and direct-acting steam and power pumps to centrifugals, and from large gas engines to turbo-electric units. During the past year the volume of the company's business has been affected adversely by the temporary slackness of buying by the railroads, oil producers and refiners, and central power stations, a condition which is now beginning to correct itself. The development of new lines made necessary by the foregoing conditions is obviously a slow process, but very definite results were obtained during 1925 by bringing to a condition for marketing improved designs of centrifugal pumps. An increased market was found for certain new developed types of compressors as well as for pumps for deep well work, and there was added to the line of products the two-cycle solid injection trunk-piston type of Diesel oil engine. There has been a notable increase in the bookings and inquiries for small and medium sized gas engine compressors."

"Satisfactory progress has been made in the construction and test of the double-acting two-cycle engines on order. The design of these engines permits the construction of an engine lighter in weight and very compact.

It may be noted in this connection that the first large marine double-acting Diesel engine has recently been completed for the United States Shipping Board conversion program. During the endurance tests from Feb. 2 until March 4, the engine met all of its specifications. Since first described in *Engineering News-Record*, Aug. 28, 1924, p. 360, this machine has developed from a single cylinder, 600-hp. experimental unit to the present four-cylinder marine type, having a rated output of 2,900 hp. It is said that definite test data on these engines will be available as soon as released by the Shipping Board.

Business Notes

BRIDGEPORT BRASS CO., Bridgeport, Conn., announces that Warren D. Blatz, general sales manager, and Walter R. Clark, general works manager, have recently been appointed to the board of directors. Mr. Blatz started with Bridgeport Brass Co. in 1916 while Mr. Clark has been with the company since 1900.

E. O. SHREVE, manager, San Francisco office, General Electric Co., since 1918, has been named manager of the industrial department of the company with headquarters at Schenectady, filling the vacancy caused by the recent death of A. R. Bush.

HADFIELD-PENFIELD STEEL CO., Bucyrus, Ohio, announces that its steel foundry department will operate as a separate unit effective March 1. The new company will be known as the Era Steel Co. and will have charge of the sales as well as the manufacture of the manganese and alloy steel products of the Hadfield-Penfield Steel Co.

EDWARD W. WEILER, formerly of the General Electric Co., has become associated with the Eureka Tool & Machine Company, Newark, N. J.

C. L. AILES has been employed as advertising manager by the Galion Iron Works & Mfg. Co., Galion, Ohio. Mr. Ailes had been for some time assistant advertising manager of United Alloy Steel Corp., Canton, Ohio, previous to which he was in the advertising department of the B. F. Goodrich Co., Akron, Ohio.

R. S. NEWHOUSE, formerly chief engineer of the crushing and cement machinery department of the Allis-Chalmers Mfg. Co., is now vice-president in charge of engineering of the Cowham Engineering Co., Chicago. As manager of the engineering department, Mr. Newhouse, will be responsible for the operation of the plants controlled by that company. The Cowham Engineering Co. has recently announced the proposed erection of a plant at Tampa, Fla., for the Florida Portland Cement Co., and one at La Salle, Ill., for the Central States Portland Cement Co.

CHAIN GRATE INCINERATOR CO., INC., Pittsburgh, Pa., has been organized with $100,000 capital stock to design, sell and operate chain grate incinerators at incinerator plants. The company has no manufacturing facilities but will purchase all requirements, except the stokers and appurtenances, in the open market. Officers include: president, William F. Hill; vice-president, J. R. Moore; secretary and treasurer. C. R. McMillen; sales manager, W. J. Springborn.

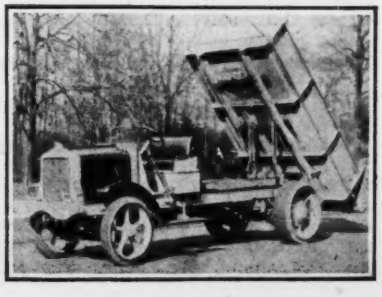
FEDERAL METER CORP., East Orange, N. J., announces that Edward Shedd is now associated with its sales force to cover the New England territory. Mr. Shedd was formerly connected with the Thomson Meter Co.

MAXIM SILENCER CO., Hartford, Conn., manufacturer of silencers for industrial machinery, has appointed W. O. Whitney sales manager.

Equipment and Materials

Many Refinements on New Heavy-Duty Dump Truck

A new heavy-duty dump truck, known as Model 52-D, has recently been introduced by the White Co., Cleveland, and contains many refinements not included in the older models. Among the most important is an auxiliary transmission affording the equivalent of five speeds, and giving extra low gear pulling power. Incorporated in the same case with the auxiliary transmission is the mechanism which operates the dumping hoist. The tapered dump body



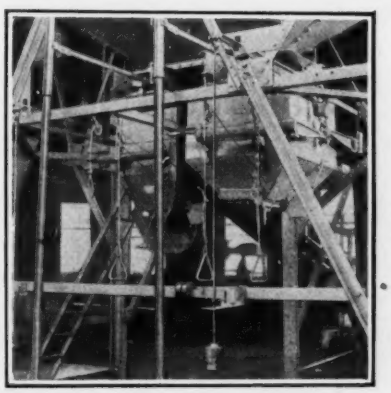
is raised on arms and links by means of a gear drive. The body lifts to an angle greater than 50 deg. and is lowered by the same mechanism that hoists it. It can be lowered while the truck is in motion. At normal rest position and at the extreme dumping angle the body is automatically stopped. Power is transmitted in an actual straight line from the starting crank to the rear axle. Two other features are an improved and patented oil system and a double reduction gear drive.

A double-acting tail gate facilitates dumping and low body sides make loading from the ground exceptionally easy. The dumping mechanism is set solidly down in the frame in a dirt-proof and weather-proof housing, the gears running in oil.

Other new features include tubular type radiator, spring cradles on the frame, heavier easy-working steering gear, an air temperature regulator that saves fuel and adds to engine efficiency, heavy springs, reinforced frame of chrome nickel steel, and brakes with drums of a special metal that is said to insure quick and certain stopping.

Proportioning Concrete Aggregate by Weighing Hoppers

Concrete aggregates are proportioned by weight to offset the bulking action due to changes in the percentage of moisture content. Since the bulking of sand is much more marked than in stone or gravel, the Butler Bin Co., Waukesha, Wis., has arranged



separate hoppers for coarse and fine aggregates arranged so that both sand and stone can be weighed, or that the sand can be weighed and the stone measured.

For weighing both aggregates two individual scales, receiving hoppers and control gates are provided. The weighing device consists of a receiving hopper fastened to a five point suspension scale and a horizontal extension lever projecting to the outside of the bin. A vertical rod extends down from the end of this lever with pans for weights convenient to the operator. A filling gate is attached to the bottom of the storage bin with operating lever extending down close to the ground. The receiving hopper is provided with a bottom discharge door controlled by a cable running from the latch to a place convenient to the operator. The scale is arranged for any weight by pound variations. A draw-off chute with control gate is provided on the receiving hopper so that any excess can easily be drawn out of the hopper.

It is claimed that the scale is very easily set up in the field since it bolts on to the bin as one unit with the gate, scale and hopper assembled. There are no delicate field adjustments on this scale requiring expert attention, yet it is claimed to be very accurate and sensitive. It is not affected by the weather and there is little to get out of order.

Where a two-compartment bin is used and both aggregates weighed and loaded at the same place, a single scale may be used for both materials. This outfit consists of a double filling gate with separate control levers for each material; a two compartment receiving hopper with separate discharge gates for each compartment, so arranged that each can be opened separately or both together. The operation of this type is described as follows: For 1,850 pounds of stone, place 1,750 pounds on the lower weight pan, open the filling gate until the beam rises and then close the gate. Next place a 100 pound weight on the lower weight pan and gradually fill until the scale balances. Then if 950 lb. of sand is required place a weight of 850 lb. on the upper weight pan, open the sand gate and shut when beam rises. Next place the 100 lb. weight on the pan and slowly fill until the beam rises again. A chute and gate is provided in each compartment of the scale hopper for drawing off in case of overweight.

Lettering Guide for Drafting Work

The Normograph, a new piece of drafting equipment being introduced by the Keuffel & Esser Co., New York City, consists of a transparent xylonite templet and a metal guide which attaches to the T-square. In the templet is a system of perforations for forming the letters and numerals. Many of the characters can be drawn by means of a single opening, but where the letter or numeral is in the form that one opening will not answer to complete it, two openings are used. As shown in the illustration, the templet is manipulated by means of a metal guide into the jaws (a), of which it is inserted. The shoulder (b) of the guide is held against the working edge of the T-square or straightedge, the body of the guide resting upon the upper face of the straightedge.

By this means the templet may be moved and be kept sufficiently far above the lettering surface to avoid all danger of smearing the lettering. The brass pen supplied with the Normograph is shaped like a funnel, having a considerable capacity. This pen may be inserted either in a special metal holder or in an ordinary penholder.

Gooseneck Boom Useful for Light Steel Erection

The Brownhoist crawler crane illustrated, equipped with an extension gooseneck boom, has been recently used by the Austin Co., contractors, in erecting steel on the Palace of Agriculture building for the Sesquicentennial Exposition at Philadelphia. The gooseneck extension was designed jointly by the Brown-

hoist and Austin engineers. The capacity of the main boom is 10 tons at 12-ft. radius, while the gooseneck extension has a capacity of 1,000 lb.

Publications from the Construction Industry

Slate Roofs—NATIONAL SLATE ASSOCIATION has made available an 84-p. catalog containing much practical data, drawings and specifications on roofing with slate, all of which can be put to practical use by the contractor, the engineer, and the owner, interested in slate as a construction material.

Asphalt Plant—WARREN BROTHERS Co., Boston, Mass., describes its utility asphalt plant in its catalog No. 879. The booklet is entirely devoted to this one piece of equipment, the drying, mixing and power units of the plant being separately illustrated and described.

Auto Trucks—AUTOCAR Co., Ardmore, Pa., has issued a 47-p. booklet entitled "Auto Car Trucks for Building Roads." The booklet is replete with illustrations of road-building projects upon which Autocar trucks are being used, and the testimonies of many contractors who have used these trucks fill about half of the pages.

Engineering News-Record Statistics of the Construction Industry

Apr. 1, 1926 — *in the United States* — Vol. 96, No. 13

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1925 to Date

April, 1926	**207.05**
March, 1926	207.65
April, 1925	209.55
Peak, June, 1920	273.80
1913	100.00

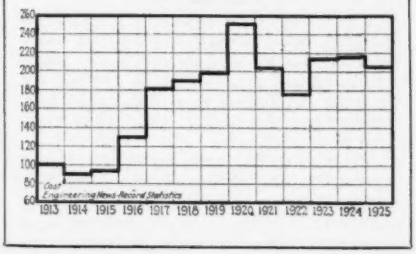
1925

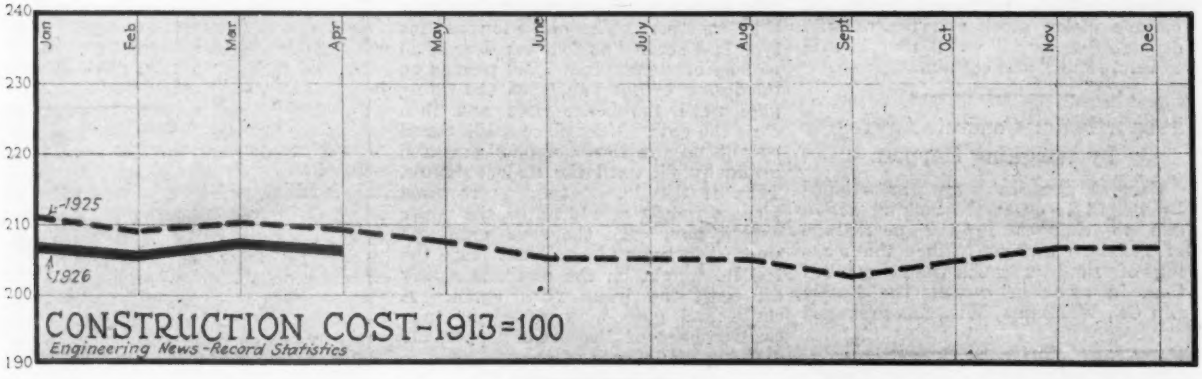
Jan....	210.40	May...	207.20	Sept..	202 10
Feb....	209.70	June...	204.60	Oct...	205.35
March.	210.20	July....	204.60	Nov. .	205.95
April..	209.55	August.	204.60	Dec...	205.95
January, 1926..	207.15	February, 1926..	206.55		

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is 0.2 per cent below March, 1926, owing to drop in materials prices in excess of increased labor costs. The average rate for common laborers is 54¼c. per hr. for the entire country as compared with the same rate one month ago and one year ago. Thus general construction cost is over one per cent below a year ago and 24 per cent under the peak; it is 107 per cent above the 1913 level.

YEARLY

1913 to 1925





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1925 to March, 1926

March, 1926	**240**
February, 1926	187
March, 1925	161
Peak, August, 1925	266
1913	100

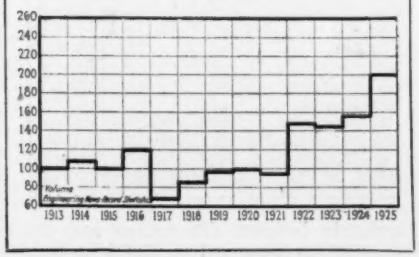
1925

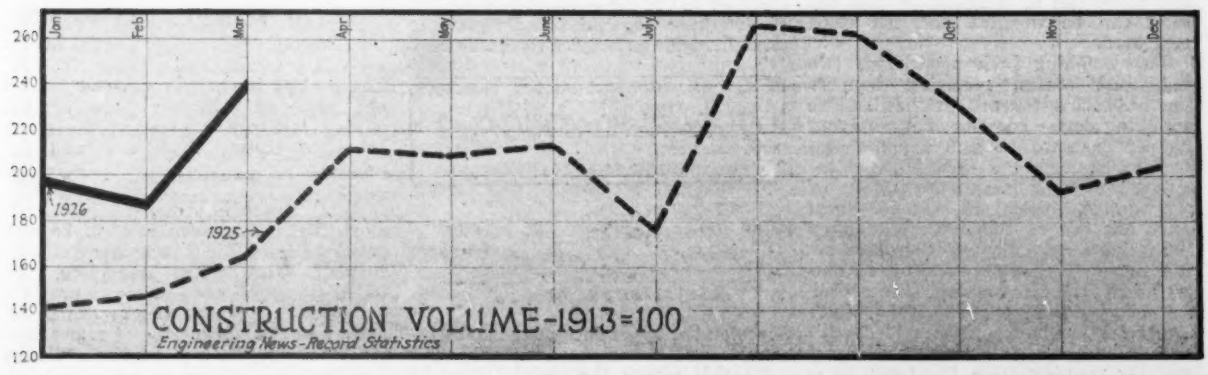
January...	141	May....	209	September..	262
February..	145	June....	214	October....	233
March....	161	July.....	178	November..	194
April.....	211	August...	266	December...	206
January, 1926.....					198

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 240 for the month of March, and 201 for the whole of 1925, as against 100 for 1913. This means that the actual volume of construction in 1925 (not the mere money-value of the contracts let that year) is 101 per cent above the volume of construction for 1913. The monthly volume number, 240 for March, 1926, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

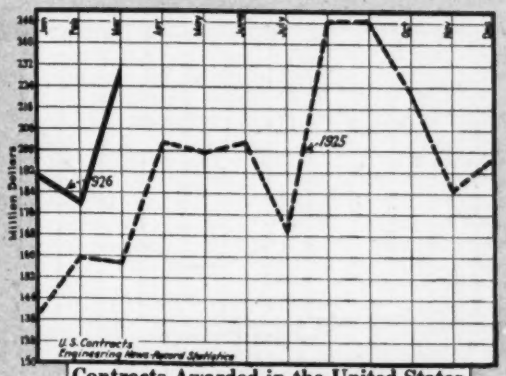
YEARLY

1913 to 1925

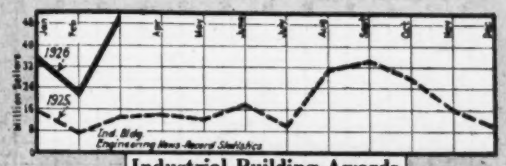




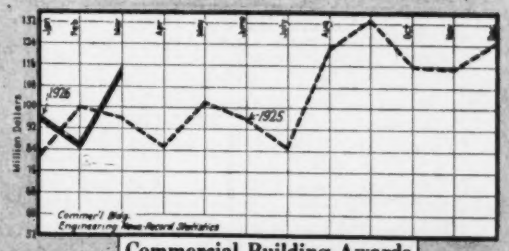
Monthly Statistics of the Construction Industry



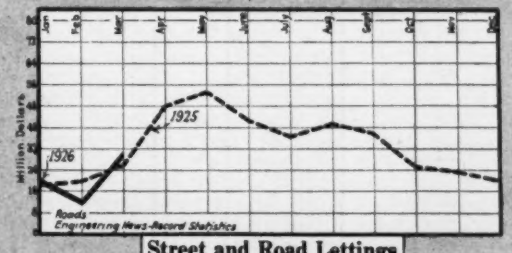
Contracts Awarded in the United States
Reported in E. N.-R.



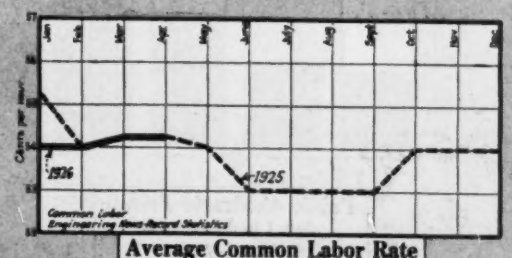
Industrial Building Awards
$40,000 and Over



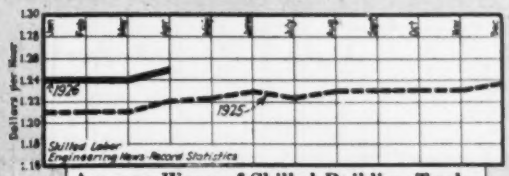
Commercial Building Awards
$150,000 and Over



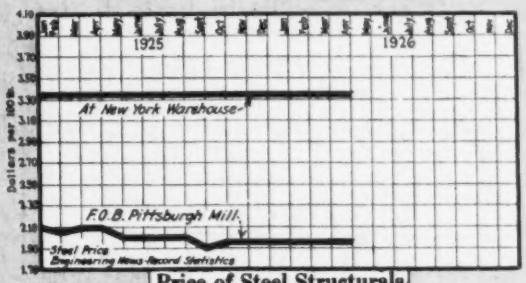
Street and Road Lettings
$25,000 and Over



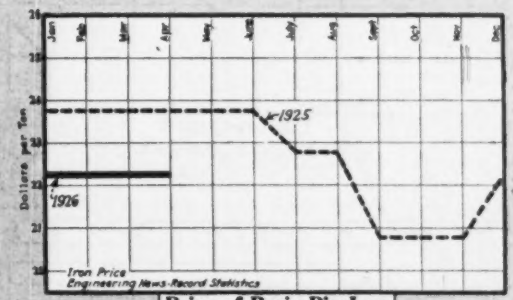
Average Common Labor Rate
Pick and Shovel Men



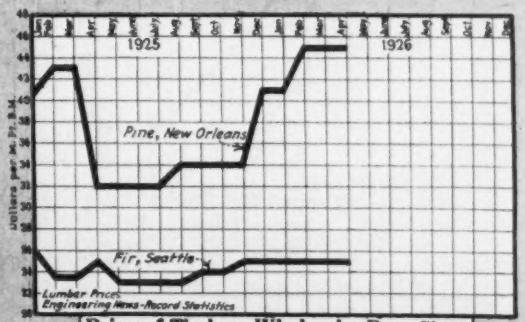
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



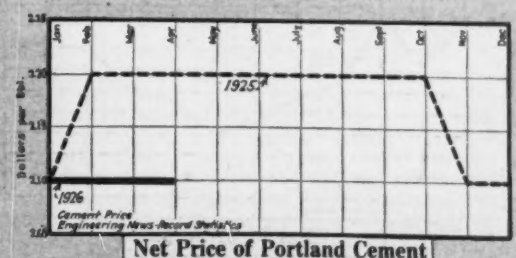
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh

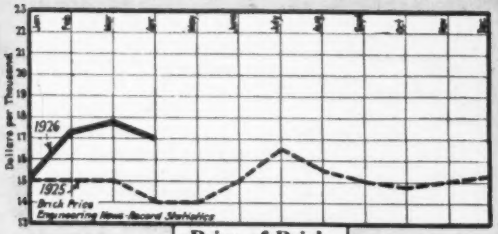


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

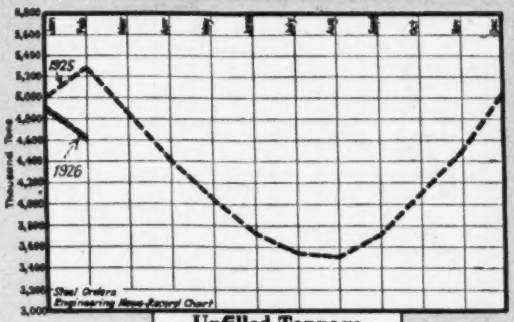


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

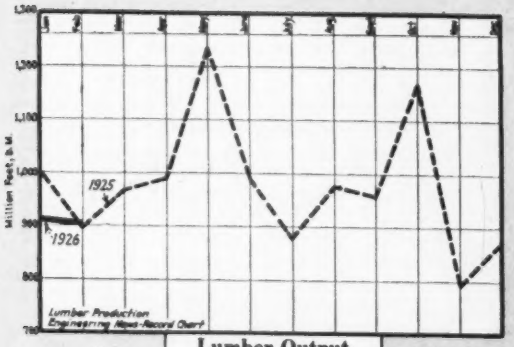
Monthly Statistics of the Construction Industry



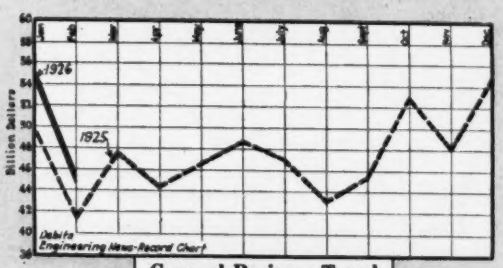
Price of Brick
At Dock, New York



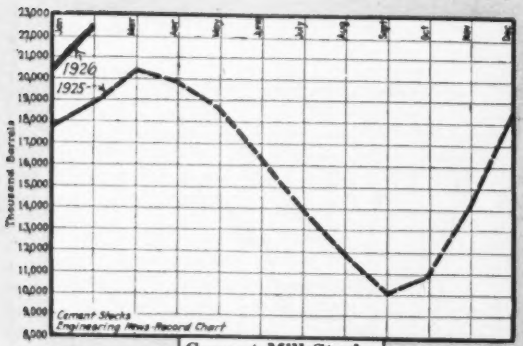
Unfilled Tonnage
On Books of U. S. Steel Corp.



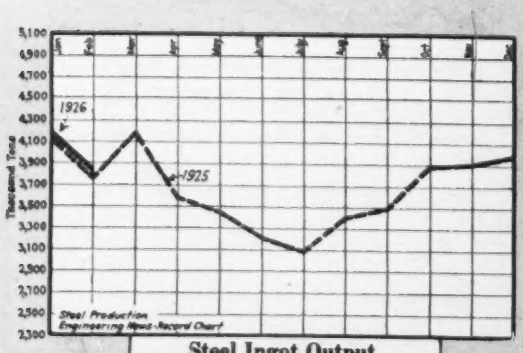
Lumber Output
Nat. Lumber Mfrs. Assn.



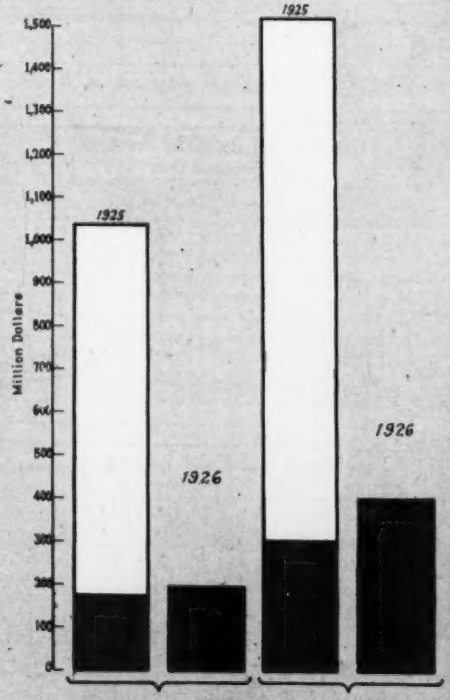
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Bureau of Mines



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.

Contemplated Construction During First Quarter 17 Per Cent Greater Than For Same Period Last Year

Road Building Most Active In The South

ENGINEERING construction contracts awarded in the entire United States during March, represented a heavier total money value than for the corresponding month in any year since 1913.

This work consisted of industrial buildings valued at $40,000 and over and commercial, public and other buildings worth $150.000 and up. Waterworks of $15 000 and over and other public work at a minimum of $25,000 were included.

The March total was $230,320.000 as against $180,032,000 for the month preceding and $155,262,000 for the corresponding period last year. This represents a gain in actual physical volume of materials used of 28 per cent over February and 49 per cent compared with March, 1925.

The gain extended to all classes of construction except Federal Government work, private bridge projects and privately owned unclassified jobs.

In money value of March lettings New York State led, with Maryland next and Pennsylvania third, after that in the order named came California, Illinois, Ohio, Florida, and Michigan.

Less than half of the forty-eight states realized gains, comparing contract totals, Jan. 1 to date, with the corresponding period last year. The twenty showing increases were as follows: Connecticut, Pennsylvania, Maryland, West Virginia, North Carolina, Georgia, Alabama, Florida, Mississippi, Louisiana, Kentucky, Ohio, Indiana, Illinois, Michigan, Arkansas, Nebraska, Colorado, New Mexico and Arizona.

In half of these states the gains in money value were due to large commercial buildings. Streets and roads, however, formed the principal element in the totals for West Virginia, North Carolina, Georgia, Alabama and Mississippi.

Industrial buildings led in Maryland, Kentucky, Indiana, and Arizona. The activity in New Mexico was mainly in Federal Government work.

Contemplated projects, definitely reported as proposed, totaled $1,653,771,000 for the first quarter of 1926, a gain of 17 per cent over the same period last year. This should result in a commensurate increase in both number and value of contracts for the second quarter of the current year.

Value of Contracts Let in the United States and Canada, March, 1926

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date U. S.	Canada
Waterworks	$431.000	$1,198,000	$1,147,000	$1,239,000	$1,715,000	$492.000	$6,222,000	$15,408,000	$30,000
Sewers	.....	1,058,000	99,000	2,993,000	695,000	1,114,000	5,959,000	18,802,000	154,000
Bridges	133,000	1,379.000	1,423,000	1,102,000	485,000	203,000	4,725.000	14,241,000	.....
Excavation, drainage, etc	.....	722.000	1,595,000	235,000	.....	105,000	2,657,000	6,518,000	.....
Streets and roads	.....	7,258,000	7,859,000	3,355,000	5,891,000	6,007,000	30,271,000	62,449,000	1,100,000
Industrial building	650.000	40,710,000	1,785,000	3,537,000	972,000	2,090,000	49,944,000	107,416,000	2,750,000
Commercial building	9,204,000	36,563,000	10,961,000	33,495,000	12,745,000	11,970,000	114,938,000	309,363,000	5,209,000
Federal Government	.....	716,000	162,000	55,000	132,000	122,000	1,187,000	10,411,000	.....
Unclassified	1,365,000	9,952,000	118,000	513,000	2,020,000	449,000	14,417,000	56,391,000	1,565,000
March 1926	$11,983,000	$99,556,000	$25,140,000	$46,524,000	$24,565,000	$22,552,000	$230,320,000	$600,999,000	$10,818,000
February, 1926	8,857,000	63,329,000	32,453,000	37,458,000	20,253,000	17,682,000	180,032,000	.....	4,752,000
March, 1925	19,160,000	45,859,000	13,381,000	25,678,000	34,155,000	18,678,000	156,911,000	.....	2,559,000
Jan. 1 to date 1926	28,812,000	233,970,000	82,448,000	124,883,000	70,639,000	60,247,000	600,999,000	.....	22,954,000
Jan. 1 to date 1925	43,776,000	167,960,000	44,741,000	68,691,000	88,177,000	68,079,000	481,424,000	.....	9,078,000

Labor Rates and General Conditions Throughout the Country

Proposed Projects Insure Active Employment Until Mid-Summer

WITH the money value of awarded contracts for engineering construction, Jan. 1 to Apr. 1, 25 per cent ahead of the corresponding period last year and work definitely reported as proposed, 17 per cent greater than during the same months in 1925, a physical volume substantially above the peak year 1925 is practically assured for the first half of this year.

Building permits reflect the situation with regard to buildings only and throw no light on the trend of contract letting beyond the month following. Proposals cover all construction, particularly engineering projects, such as dams, water-works, highways, sewers, etc., and over 88 per cent of the proposed work may be counted upon to reach the contract stage within three months.

The trend of construction volume having been fairly well determined up to July 1 it remains to be seen whether or not the course during the last half will run somewhat below that of 1925.

Awards for the first two months of 1926 ran fairly true to the typical seasonal variation in contract letting. March, however, was abnormally high in volume.

Sales of fabricated steel structurals, Jan. 1 to Mar. 1, were 5 per cent heavier than for the same period last year.

Reserve stocks of materials are being kept as near actual needs as possible. Production schedules seem geared to this hand-to-mouth practice of buying with the possible exception of the following industries: iron and steel, lumber, paper and printing, chemicals and oils, tobacco and automotive products.

Over-production and the hardening of money rates are two things to be closely watched during the next few months. The former will precipitate the same condition in the materials market as recently occurred on the stock exchange. The latter will indicate the termination of the speculative building boom.

The outstanding controversies and settlements affecting building trades mechanics are briefly outlined as follows:

An advance of $1.50 per day was granted the key trades among New York building mechanics, retroactive to Mar. 1, 1926. This makes the base pay $12 per day as against $10.50 last year. Stone setters were awarded a base pay of $14 against the former daily rate of $12. The situation regarding helpers and apprentices has not yet been completely cleared up. The bricklayers' base rate of $1.50 per hr. will remain in effect until May 1 at which time existing contracts expire. Steamfitters and helpers went on strike Mar. 29 for an advance of $1.50 for the former and $1 per day for the latter. The rise, if granted the journeymen, would bring them to the $12 per day base accorded most of the other crafts. The principal point of contention is the increase demanded by helpers. There is little danger of the strike spreading to the other trades if the employers refrain from introducing non-union steamfitters and helpers.

Cleveland building laborers, including hod carriers, are on strike for $1 per hr. About 25 per cent of the independent contractors have signed for the new scale.

Kansas City, Mo., lathers were granted an increase of $1 per day, retroactive to Mar. 1, 1926. The nine other crafts presenting similar demands are as follows: tilesetters, marble setters, hoising engineers, carpenters, plasterers, plumbers, steamfitters, tile and marble setters helpers, marble masons foremen.

Present Chicago building trades agreement expiring June 1, will leave the industry in a state of uncertainty unless the questions of open shop and right of sympathetic strike are settled

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.75	.00@1.10	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.35@.87½	.75@1.25	.50@.75	.....	.75@1.75	.20@.40
Boston	1.25	1.10	1.10@1.30	.75	1.10	+1.25	—.50@.65
Cincinnati	1.50	+1.31½	+1.31½	+.95	1.25	+1.31½	+.58
Chicago	1.50	1.37½	1.37½	.87½	1.37½	1.37½	.82½@.87½
Cleveland	1.50	1.25	1.30	.87½@1.00	1.00	1.50	+.87½@1.00
Dallas	1.62½	1.12½	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.70@1.00	.85@1.00	.90	.85@1.00	1.12½	.50@.60
Kansas City	+1.50	1.12½	1.25	.90	+1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	.87½	.80	1.00	.50
Minneapolis	1.12½@1.25	.87½@90	.87½	.71½	....	.87½	.45@.55
Montreal	1.00	.80	.56¾	.30@.35	.50	.80	+ 25@.30
New Orleans	1.25	.90	1.00	.65	.85	1.25	.35@.40
New York	1.50	+1.50	1.50	1.00	1.00@1.12½	1.50	.62½@.75
Philadelphia	1.62½	1.12½	1.02½	1.12½	1.00	1.12½@1.25	.45@.50
Pittsburgh	1.62½	+1.50	+1.37½@1.50	+1.12½	....	1.43¾	+.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

in the meantime. Existing wage schedules remain unaffected.

In Cincinnati twenty-two building trades received wage increases ranging from 2½ to 6¼c. per hr. The present agreement took effect Mar. 24, 1926 and will continue for thirteen months. New rates for several of the principal building trades are shown in the accompanying tabulation.

Los Angeles tile and marble setters are on strike for an increase of 12½c. per hr. Bricklayers went on strike in sympathy with the tile and marble workers.

Philadelphia carpenters, cement finishers and electrical workers demand wage increases. Masons received a wage advance bringing present scale to $1.40 per hr. instead of $1.50 as at first demanded by the craft.

St. Louis painters demand an increase of 7½c. per hr. over the present scale of $1.30 and the establishment of the five-day week, eight hours per day. Asbestos workers ask an advance of 17½c. over the present rate of $1.25 per hr.

Monthly Prices of Construction Materials

Ups and Downs of the Market

BRICK prices tend upward in the Northeastern districts while tile is advancing in the West. Bars, plates and galvanized steel sheets average higher than a month ago at Pittsburgh. Lumber declines are in excess of advances throughout the country. Iron and steel scrap and linseed oil appear easier, while light rails dropped $1 to $3 per ton at mills, during the month. Firmness with little tendency to change is noted in aggregates, lime, cement, structural shapes, rivets, spikes, piling (steel sheet and pine) wire rope and explosives.

Pig Iron—Prices are noticeably below those in effect at this time last year in 75 per cent of the published quotations. From the trend in buying for third quarter delivery, it may be assumed that prices will hold for a time at present levels, which have been in effect since December, 1925.

Railway Supplies—Light rails are down about $1 per ton, compared with a month ago; standard rails retain the price stability shown during the past four years. Track bolts are firmer; ties remain unchanged from Mar. 1 levels.

Pipe—Pressure pipe demand is steady with improvement noted in cast-iron soil pipe buying. The only changes noted in the price line-up are a slight firmness in c.-i. pipe in the San Francisco district and considerable fluctuation in other Western cities of sewer pipe quotations, sizes above 6-in.

Road and Paving Materials—The seasonal acceleration in demand for materials in this group has resulted, thus far, in no marked fluctuations in prices except in the West. Asphalt advanced sharply in Kansas City and St. Louis and declined in Detroit.

Sand, Gravel and Crushed Stone—Opening of navigation and relief from freezing weather have combined to increase the available supply of aggregates, meanwhile seasonal enlargement of demand has prevented any marked decline in prices. Gravel is down 5c. in Chicago and is 15c. per cu.yd. higher in Detroit, compared with the March levels; sand dropped 10c. in the former and 14c. per cu.yd. in the latter city, at the same time seventeen other cities reported that no changes occurred in prices of sand and gravel. Crushed stone remained firm and unchanged.

Lime and Cement—Lime, all grades, went up $2.50 to $3 per ton in Detroit, during the month. Dallas prices declined $2 in hydrated finishing and the same grade rose $1 per ton in Kansas City, Mo., since Mar. 1. In most of the other large cities lime and cement displayed the usual price stability.

Brick and Hollow Tile—The price trend in brick is upward. Boston prices jumped 50c.; Minneapolis, 75c.; and Montreal, $2.75 per M. during the past month. San Francisco district records a drop of 50c. per M. from the March level. In New York the supply is no more than sufficient to meet demands. Tile prices are firm and stable in the East. In the Detroit, Minneapolis and Kansas City districts, however, price advances are developing.

Structural Steel—Bars and plates are about 10c. per 100 lb. above the March average. Mill and warehouse quotations on structural shapes remained at practically the same levels during the month. Structural steel bookings up to Mar. 1 were heavier than those for the corresponding period last year.

Lumber—Price declines on all grades and sizes are considerably in excess of advances, comparing present levels with those in effect a month ago. All of the principal advances, however, were in the Northeastern states, while the declines were fairly well scattered throughout the country. Fir quotations in the West show either no change or a weakening tendency. Pine prices held steady during the first week of March and then began to ease off slightly in some of the Southern districts.

Next Week—The Real Construction Shortage—Created by a New Plane of Demand

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

CINCINNATI	Apr. 1	One Year Ago
No. 2 Southern (silicon 2.25@2.75)	$24.05	$26.05
Northern Basic	24.27	23.77
Southern Ohio No. 2 (silicon 1.75@2.25)	24.27	23.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	28.37	32.25
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	22.00	22.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.16	24.76
Virginia No. 2 (silicon 2.25@2.75)	29.17	30.17
Basic	23.16	24.76
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	23.00	22.00
No. 2 Foundry Southern (silicon 2.25@2.75)	26.55	28.01
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	22.27	23.77
Basic	22.27	23.77
Bessemer	22.27	23.77

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	**$14.75**	$13.25@$13.75	$13.00@$13.50
Stove plate	**11.75**	14.50@15.00	14.00@14.50
No. 1 machinery cast		16.50@17.00	17.00@17.50
Machine shop turnings	9.75	8.00@8.50	8.00@8.50
Cast borings	*11.75*	12.00@12.50	8.00@8.50
Railroad malleable	*16.50*	**15.50@16.00**	17.00@18.00
Re-rolling rails	*13.00*	14.75@15.25	16.50@17.00
Re-laying rails	*23.00*		21.00@22.00
Heavy melting steel	*11.50*	12.25@12.75	

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Apr. 1	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	
Standard openhearth rails	43.00	43.00	43.00	43.00	$51.00
Light rails, 8 to 10 lb.	*35.00*	33@36	34@36	1.80@1.90	2.05*
Light rails, 12 to 14 lb.	*35.00*	33@36	34@36	1.80@1.90	1.88*
Light rails, 25 to 45 lb.	*35.00*	36.00	34@36	1.80@1.90	1.84*
Re-rolled rails	**32@33**	27@32	.....	34@36	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.35	$1.65
Chicago, empty cell creosoted	1.70	2.00
Chicago, zinc treated	1.50	1.80
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.15	1.45
St. Louis, zinc treated	1.55	1.85
St. Louis, red oak, plain	1.05	1.35
St. Louis, sap pine-cypress	.90	1.20
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Apr. 1	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.90	$3.55	$3.65	$4.35	$3.00
Track bolts	3.90@4.15	3.90@4.25	4.55	4.00	**5.85**	3.90
Standard section angle bars	2.75	2.75	3.40	3.25@3.75	4.00	4.15

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black New York	Black Chicago	Black Birmingham	Black St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
2½ to 6 in. lap welded	48%	51%	59%	46%

	Galvanized New York	Galvanized Chicago	Galvanized Birmingham	Galvanized St. Louis
1 to 3 in. butt welded	39%	41%	50½%	36%
2½ to 6 in. lap welded	35%	38%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Burlington, N. J.	New York Apr. 1	New York One Year Ago
4 in.	$45.00@46.00	$52.00@54.00	$54.60@56.60	$56.60@57.60
6 in. and over	41.00@42.00	48.00@50.00	50.60@52.60	52.60@53.60

	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	$53.20@54.20	$53.20@54.20	$51.50	**$56.00**
6 in. and over	49.20@50.20	49.20@50.20	47.60	**52.00**

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Apr. 1	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$48.00	$40.00	$45.00	.....	$73.00
4	60.00	50.00	40.00	56.00	$76.50	110.00
5	.....	.....	.....	80.00	97.75	118.00
6	90.00	92.00	70.00	100.00	127.50	150.00
8	160.00	160.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	....	$0.108	$0.10	.....	$0.09	$0.12	.....
4	....	.108	.10	$0.10	.09	.15	$0.15
5	....	.1485	.135	.....	.13½	.18	.18
6	$0.21	.1485	.135	.14	.13½	.21	.21
8	.35	.243	.21	.225	.21	.30	.325
10	.52	.2835	.315	.315	.31½	.42	.476
12	.66	.3645	.45	.405†	.40½	.56	.612
15	1.14†	.486	.54	.675†	.54	.92	1.02
18	1.65†	.675	.75	.945†	.75	1.32	1.53
20	1.98†	.81	.90	1.26†	.90	.....	.....
22	2.65†	1.08	1.20	.....	1.20	.....	1.564
24	2.97†	1.215	1.35	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.665	2.45†	2.75	3.00	3.34
30	5.16†	2.664	2.952	3.00†	3.75	3.60	4.06
33	6.98†	3.60	3.96	3.55†	4.50	....	4.99
36	8.00†	4.10	4.51	3.95†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	$0.135	$0.20	$0.30	$0.60	$2.00†	$5.50†
Minneapolis	.....	.....	**.25**	**.45**	**1.50**	*4.56*
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.72†	2.60†	.....
Los Angeles	.1625	.195	.275	.495	1.65	.....
New Orleans	.115*	.117*	.2777	.695	1.442	.....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal	.68‡	.....	.45	.70	1.35	4.50
Detroit	*.105*	*.1575*	*.245*	*.4725*	*2.16†*	*5.6375†*
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	**.335**	.52	**2.10†**	*3.16†*
Philadelphia	.11	.17	.26	.50	1.67	3.80

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Apr. 1	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065 @$0.07	$0.065 @0.07
New York, 65% asphalt	(at terminal)	.0675@.0725	.0675@.0725
New York, binder	(at terminal)	.07 @.075	.07 @.075
New York, flux	(at terminal)	.07 @.075	.07 @.075
New York, liquid asphalt	(at terminal)	.07 @.075	.07 @.075
St. Louis, 40@50% asphalt		.057	.0592
St. Louis, 50@60% asphalt		.0575	.0597
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00	$18.50
Boston (*Mexican*)	22.50	18.50
Chicago (*Texas*)	27.00	23.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities* (*Standard*)	27.60	21.60
St. Louis (*Mexican*)	**26.00**	**23.00**
Baltimore (*Mexican*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	24.60	20.40
Detroit (*Mexican*)	*22.25*	*18.50*
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermudez*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	**27.30**	**22.30**
Los Angeles ("*D*" *grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	26.00	17.00

* F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$147.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.18 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	*3.15* per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.60. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.50
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.75
Seattle	4	16	Off market
Minneapolis	3½	16	*2.40*
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	.....
Cincinnati	3½	16	2.35
Kansas City	4	16	**3.75**
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor f.o.b., per cu.yd. is as follows:

	Gravel 1½ In. Apr. 1	Gravel 1½ In. One Year Ago	Gravel ¾ In. Apr. 1	Gravel ¾ In. One Year Ago	Sand Apr. 1	Sand One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	*1.60*	.....	*1.60*	.....	*1.40*	.....
St. Louis	1.45	1.45	1.45	1.65	1.08	1.18
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.65*	1.65*	1.65*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40†	1.35†	1.35†
San Francisco	1.83	2.15	1.80	2.15	1.40	1.50
Boston	1.50†	1.50†	1.50†	1.50†	1.00†	1.00†
New Orleans	2.60	2.60	2.60	2.60	1.75	1.75
Los Angeles	1.15†	1.35†	1.15†	1.30†	.90*†	1.05†
Atlanta	1.90†	1.90†	1.90†	1.90†	1.50†	1.40†
Detroit	**2.17**	2.02	**2.17**	2.02	*1.48*	1.62
Baltimore	1.40	1.40	1.60	1.60	.70*†	.70*†
Montreal	1.25†	1.25†	1.25†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.50	1.45†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City	4.00‡	4.00‡	4.00‡	4.00‡	.66*†	.66*†

New York—Grits, $1.75 per cu.yd.; ready mixed $1.85.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton. ‡Joplin chats.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. city, is as follows:

	1½ In. Apr. 1	1½ In. One Year Ago	¾ In. Apr. 1	¾ In. One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	1.75	.....	1.87½	.....
St. Louis	1.93*	1.83*	1.93*	1.93*
Dallas	2.40	2.40	2.83	2.83
San Francisco	1.70	2.15	1.70	2.15
Boston	1.60*	1.60*	1.60*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	2.50	2.50	2.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.50*	2.00*	2.50*	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	1.40*	1.60*	1.40*	1.55*
Detroit	2.00*	1.50	2.00*	1.50
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	1.50*	1.80*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	2.00	2.00	2.00

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	.....	.....	2.50	.....
Birmingham, Ala	.80@.90	1.15	2.05	.....
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.80	1.80	.....	1.75
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	.....
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.25@2.75*
Chicago	23.00	18.00	.....	2.25*
St. Louis	24.00	20.00	.....	15.00‡
Boston	20.00	13.50@14.50	3.75*	3.00*
Dallas	*18.00*	.....	.....	1.85†
Cincinnati	16.80	14.30	.....	13.40‡
San Francisco	22.00	.....	.....	1.60†
Minneapolis	25.50	21.00	1.60@1.70† (brown)	1.35†
Denver	24.00	.....	.....	2.70*
Detroit	**18.50**	**15.00**	.....	**18.50‡**
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	25.00	18.00	3.50*	19.50‡
Baltimore	24.25	17.85	2.55†	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	22.50	13.00	2.20†	1.50†
New Orleans	24.00	16.00	2.50†	2.00*
Philadelphia	23.00	16.00	.....	.....
Kansas City	**19.50**	15.00	2.59*	2.10*
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Apr. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	2.20	1.35
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.65	2.50
St. Louis (Carney)	2.35	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Apr. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.50	$2.50@2.70	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	2.40	2.40	2.55
Chicago	2.10	2.10	2.20
Pittsburgh	2.09	2.09	2.19
Cleveland	2.29	2.29	2.39
Detroit	2.15	2.15	2.35
Indianapolis	2.29	2.29	2.41
Milwaukee	2.25	2.25	2.35
Duluth	2.09	2.09	2.19
Peoria	2.27	2.27	2.37
Cedar Rapids	2.34	2.34	2.44
Davenport	2.29	2.29	2.39
St. Louis	2.20	2.20	2.30
San Francisco	2.31	2.31	2.31
New Orleans	2.40	2.40	2.40
Minneapolis	2.32	2.32	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.30
Cincinnati	2.37	2.37	2.47
Los Angeles	2.52	2.52	2.80
Baltimore	**2.50**	2.35	2.50
Birmingham	2.40	2.40	2.40
Kansas City, Mo	2.35	2.35	2.28
Montreal	1.80	1.80	1.80
Philadelphia	2.41	2.41	2.41
St. Paul	2.32	2.32	2.42
Toledo	2.20	2.20	2.40

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.85	Hudson, N. Y.	$2.05
Universal, Pa	1.85	Leeds, Ala	1.95
Steelton, Minn	1.90	Hannibal, Mo	1.95
Fordwick, Va	2.05	Lehigh Valley District	1.95
Mitchell, Ind	1.95	Wyandotte, Mich	1.90
Iola, Kan	1.85	Alpena, Mich	1.75
Mason City, Ia	1.90	Richard City, Tenn	2.05
La Salle, Ill	1.95	Kingsport, Tenn	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1.66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2.46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	103	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	....	1.14	1.07	.....
067R	31	1.32	1.38	....	1.45	1.39	.....
089R	40	1.70	1.78	....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$19.00	$19.00	$19.00	$23.50
2.5	21.00	23.00	21.00	21.00	21.00	25.00
3.0	24.00	26.00	24.00	24.50	23.50	28.50
3.4	26.00	28.00	26.00	26.50	25.50	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00@2.10	$2.25	$3.24	$3.00	$3.15	$3.38	$3.20
⅝	2.10@2.20	2.35	3.34	3.10	3.25	3.43	3.30
¾	2.20@2.30	2.45	3.44	3.20	3.35	3.48	3.40
⅞	2.40@2.50	2.65	3.64	3.40	3.55	3.63	3.60
1	3.00@3.10	3.25	4.24	4.00	4.15	3.78	4.20

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	$2.55	$2.80	½	$2.95	$3.02
⅝ in.	2.65	2.85	¾	3.55	3.20
⅞	2.75	2.90	1	....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Apr. 1	One Month Ago	One Year Ago	Paving Block: 3-inch*	3½-inch*
New York (del.)	$20.40	$21.00	$17.00	$45.00	$51.00
New York (at dock)	17.00	17.75	15.00	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16.00	40.00	42.50
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	11.10	11.10	12.10	35.00	.....
San Francisco	*15.00*	15.50	15.50	.....	.....
Los Angeles	11.50	11.50	13.00	(not used)	
Boston (del.)	18.00	17.50	18.50	45.00	50.00
Minneapolis (del.)	14.25	13.50	13.50@13.60	.....	.....
Kansas City	15.50	14.50	14.50	(no market)	
Seattle	15.00	15.00	14.50	.....	42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	20.25	17.50	17.50	100.00†	68.00
Detroit (del.)	16.00	16.00	17.50	38.48	41.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	10.50	10.50	10.50	40.00	.....
New Orleans	15.00	15.00	15.00	.....	.....
Birmingham	12.50	12.50	12.50	40.00	45.00
Philadelphia	17@21	17@21	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	14.00	14.00	14@16	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Apr. 1 on Trucks*†	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1112	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12	.1667	.1743	.096	.....	.094	.156	.....
8x12x12	.2084	.2179	.135	.22	.128	.244	.....
10x12x12	.....	.....	.167	.....	.155	.....	$0.252
12x12x12	.....	.....	.215	.....	.185	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.085	$0.175	.....
Minneapolis (f.o.b. cars)	.068	.1175	$0.205
Minneapolis (delivered)	.076	.13	.225
Cincinnati	.07485	.13745	.....
Kansas City	.095	.175	.275
Denver	.075	.155	.188
Seattle (delivered)	.10	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.20	.....
Detroit (delivered)	.1095	.2821	.....
Montreal	.12	....	.....
Baltimore	.125	.27	.....
Atlanta	.0977	.1837	.....
Dallas	.10	.19	.275
Birmingham	.11	.1824	.255
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.07	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.80@1.90	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Apr. 1	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.50@2.60	$4.50	$4.50	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	2.90	$4.70	$4.60	$3.70	$3.85	$5.20	$5.00
⅝ and ¾	3.05	4.85	4.75	3.80	4.20@4.45	5.35	5.15
⅞ and 1	3.30	5.10	5.00	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.85	$3.05	$3.75	$4.28	$2.93	$4.95
Cut	2.80	2.90	....	5.30	5.00	3.15	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs $2.35@$2.50 per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $7.00 per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $5.00 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$70.00
Asphalt roofing (in barrels) per ton	25.00
Asphalt felt, per ton	72.00

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 87 per cent; "B," 89 per cent. Double thickness "AA," 82 per cent; "A," 86 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.45@$2.50	$3.60	$3.50	$3.75	$3.89
No. 12	2.50@2.55	3.65	3.55	3.80	3.94
No. 14	2.55@2.60	3.70	3.60	3.85	3.99
No. 16	2.65@2.70	3.80	3.70	3.95	4.09
Black					
*Nos. 18 to 20	3.05@3.15	4.40	3.90	4.55	4.30
*Nos. 22 to 24	3.10@3.20	4.45	3.95	4.60	4.35
*Nos. 26 and 27	3.15@3.25	4.50	4.00	*4.65*	4.40
*No. 28	3.25@3.35	4.60	4.10	*4.75*	4.50
Galvanized					
No. 10	3.60	4.70	4.25	5.00	4.65
Nos. 12 to 14	3.70	4.80	4.35	5.10	4.75
No. 16	3.85	....	4.50	5.25	4.90
Nos. 18 to 20	4.00	5.10	4.65	5.40	5.05
Nos. 22 to 24	4.15	5.25	4.80	5.55	5.20
*Nos. 26 and 27	4.30	5.40	4.95	5.70	5.35
*No. 28	4.60	5.70	5.25	6.00	5.65

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Apr. 1	New York: One Year Ago	Chicago: Apr. 1	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$0.83½*	$1.14	*$0.85*	$1.25

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price f.o.b. New York:

	Dry		In Oil	
	Apr. 1	1 Yr. Ago	Apr. 1	1 Yr. Ago
Red	$15.25	$16.25	$16.75	$17.75
White	15.25	16.25	15.25	16.25

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No. 1 L.L.Y.P.	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$43.00	$44.00	$42.50	$41.00
3x10 to 10x10	50.00	51.00	47.50	41.00
3x12 to 12x12	57.00	58.00	57.50	41.00
3x14 to 14x14	65.00	66.00	.....	41.00
3x16 to 16x16	77.00	78.00	.....	42.00

New York—Wholesale price of long-leaf pine to dealers; to contractors, delivered from lighters or cars to job, $5@$10 additional. Short-leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 Ft.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	**$48.50†**	$51.00	**$50.50**	$61.00	**$58.50†**
Seattle	.....	24.00	.....	.....	.....	25.00
New Orleans	37.00	.....	.....	.....	45.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	*60.00*	65.00
Los Angeles	.....	*36.64*	.....	.....	.....	*36.64*
Denver	.....	34.75	34.75	34.75	.....	34.75
Minneapolis	42.00	37.75	35.00	.....	44.00	37.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	56.00	...
Kansas City, Mo.	*29.00*	20.00	.....	.....	*45.00*	21.00
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	54.00	*36.00*	38.00	45.00	65.00	*36.00*
Detroit	47.75	46.75	.....	.....	61.75	46.75
St. Louis	*42.00*	.....	.....	.....	*54.00*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	**$42.50†**	$45.00	$51.00	$48.00†
Seattle	.....	20.00	.....	.....	24.00
New Orleans	75.00	.....	.....	40.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	*43.00*	50.00	*40.00*	**65.00**	**50.00**
Los Angeles	.....	*35.64*	.....	.....	.....
Denver	.....	33.25	31.25	.....	32.25
Minneapolis	42.50	35.75	34.75	37.00	34.25
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.00	.....	.....	56.00	.....
Kansas City, Mo.	*40.50*	24.00	.....	*32.00*	18.00
Birmingham	27.00	.....	.....	42.00	.....
Philadelphia	*32.00*	**36.00**	36.00	52.00	**35.00**
Detroit	39.75	37.00	.....	46.50	41.25
St. Louis	41.00	.....	.....	30.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Apr. 1	One Month Ago	One Year Ago
$2.25@2.30	$2.25@$2.30	$2.15@2.25

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.25½
New York	.27	Los Angeles	.25
Chicago	.25½	Seattle	.24
Minneapolis	.27½	St. Louis	.25½
San Francisco	.25	Montreal	.16
Atlanta	.27	Detroit	.27
Denver	.28	Baltimore	.18
Cincinnati	.21	Kansas City	.28
Dallas	.31	Birmingham	.26@.27
Philadelphia	.26		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	.225	.25
Kansas City	.205	.22
Seattle	.165	.19
Chicago	.215*	.2375*
Minneapolis	.1917	.2123
St. Louis	.2275	.2525
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2225
Atlanta	.215	.24
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.22	.24
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatin.

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$1.40@$1.45
Sulphate of copper, in bbl., per 100 lb	*4.40* @4.60
Soda ash, 58%, in bags, per 100 lb	1.38
Chlorine, liquid, tanks, per lb	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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